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Zensai

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(45) **Date of Patent: Jun. 4, 2013**

(54) **IMAGE FORMING APPARATUS**

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(73) Assignee: **Canon Kabushiki Kaisha**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/465,500**

(22) Filed: **May 7, 2012**

(65) **Prior Publication Data**

US 2012/0219313 A1 Aug. 30, 2012

Related U.S. Application Data

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(30) **Foreign Application Priority Data**

May 7, 2008 (JP) 2008-120916

(51) **Int. Cl.**
G03G 15/00 (2006.01)

(52) **U.S. Cl.**
USPC **399/12**; 399/167

(58) **Field of Classification Search**
USPC 399/12, 75, 121, 167
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,860,410	B2	12/2010	Tachiki et al.
2006/0263102	A1	11/2006	Ishii

FOREIGN PATENT DOCUMENTS

JP	6-118736	A	4/1994
JP	9-258634	A	10/1997
JP	2001-296718	A	10/2001
JP	2006-235236	A	9/2006
JP	2006-276562	A	10/2006

OTHER PUBLICATIONS

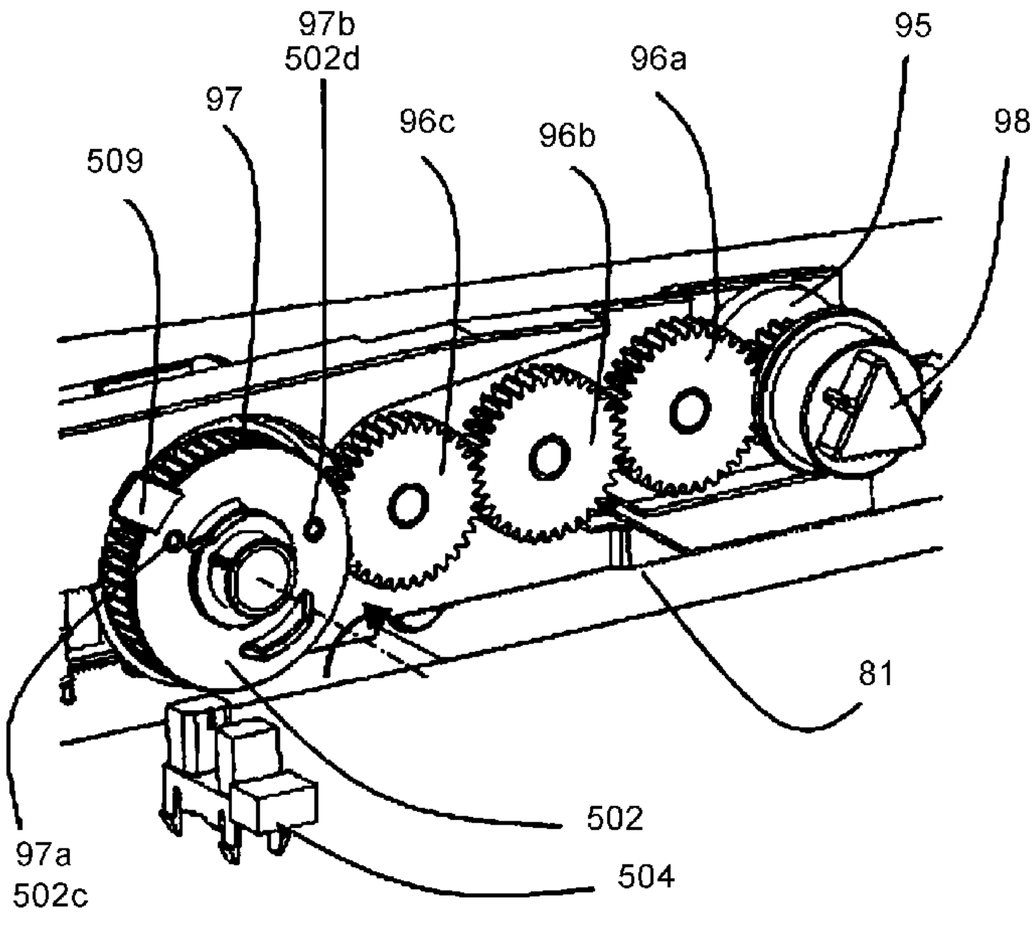
Notification of Reasons for Refusal issued Oct. 23, 2012, in Japanese Application No. 2008-120916.

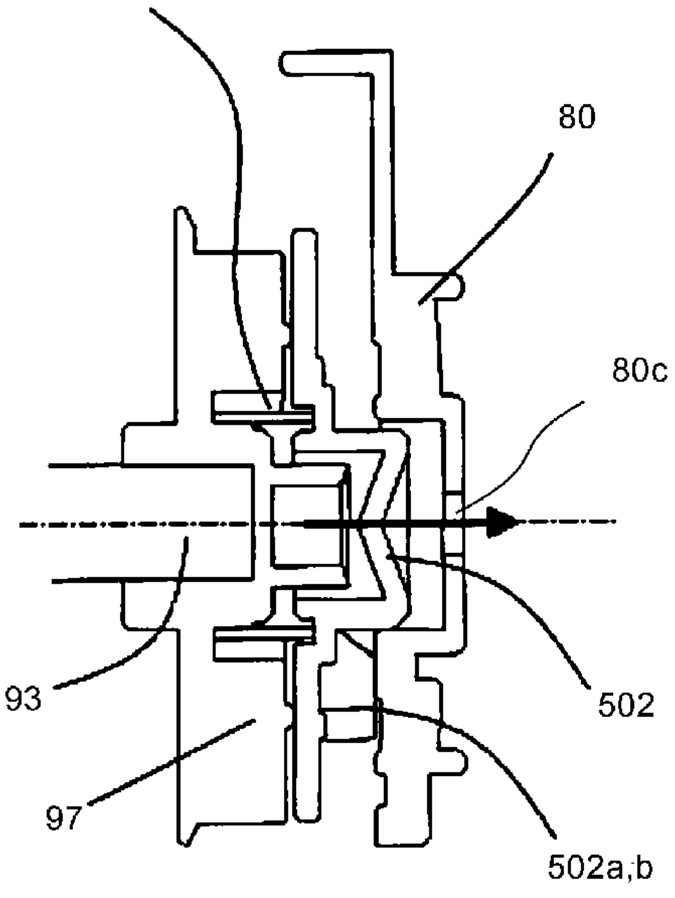
Primary Examiner — Walter L Lindsay, Jr.
Assistant Examiner — Ruth Labombard
(74) *Attorney, Agent, or Firm* — Fitzpatrick, Cella, Harper & Scinto

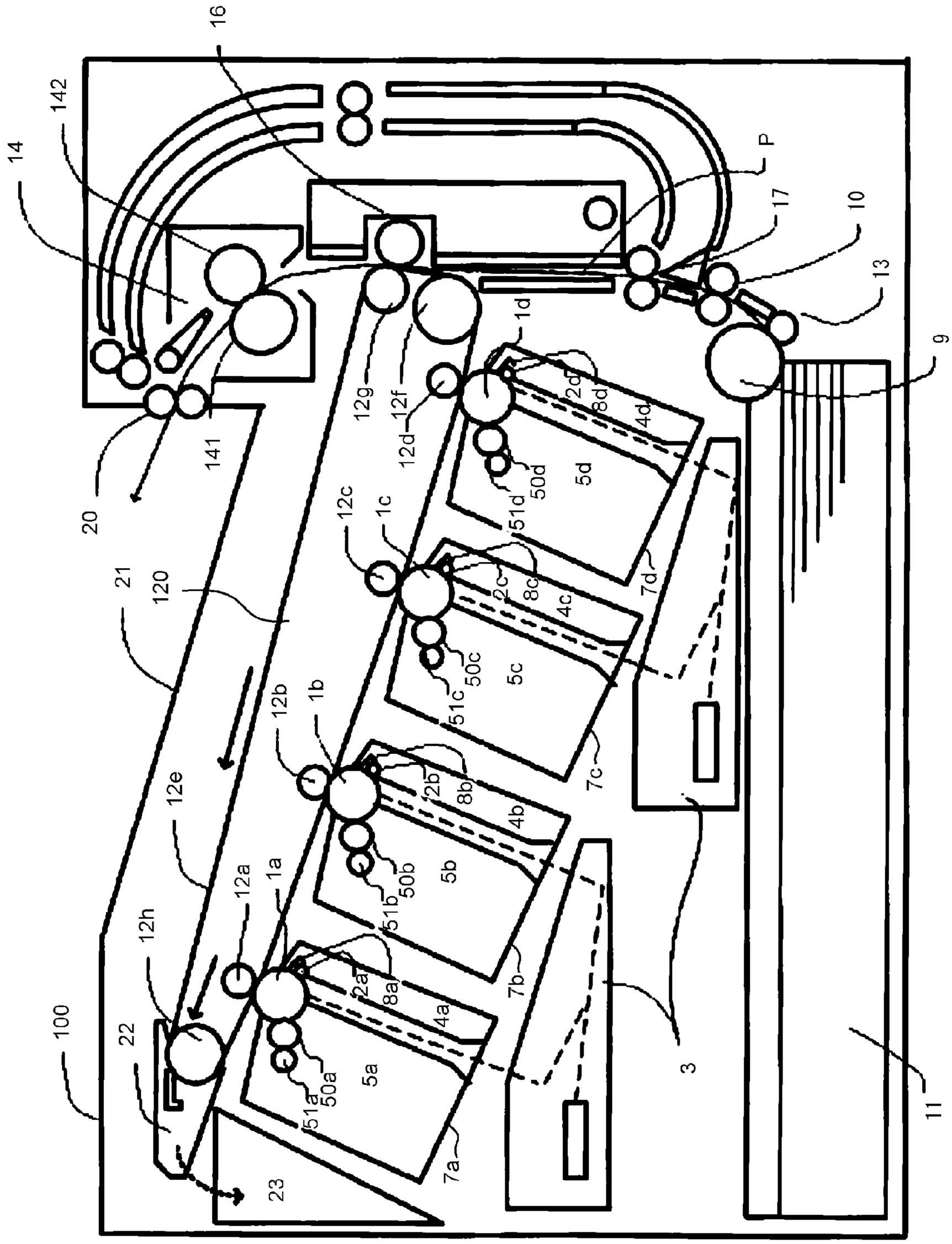
(57) **ABSTRACT**

An image forming apparatus includes a unit, which is detachably attachable to a main body of the apparatus and has a portion to be detected, and a detecting device which detects the portion to be detected in the unit. It is determined that the unit is in an unused state since both of a first state in which the portion to be detected is detected by the detecting device and a second state in which the portion to be detected is not detected by the detecting device are confirmed, and thereafter, the first state or the second state is maintained. Furthermore, there is provided a restricting member which inhibits the first state or the second state from being maintained.

17 Claims, 23 Drawing Sheets






16
142
14
P
17
10
13
9
1d
12g
12f
2d
8d
4d
12d
50d
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51d
12c
1c
2c
8c
4c
7d
50c
5c
51c
12b
1b
7c
12e
12a
1a
8b
4b
5b
50b
51b
2a
8a
4a
7b
12h
100
22
50a
5a
51a
7a
23
3
11
20
141
21
120

FIG. 1

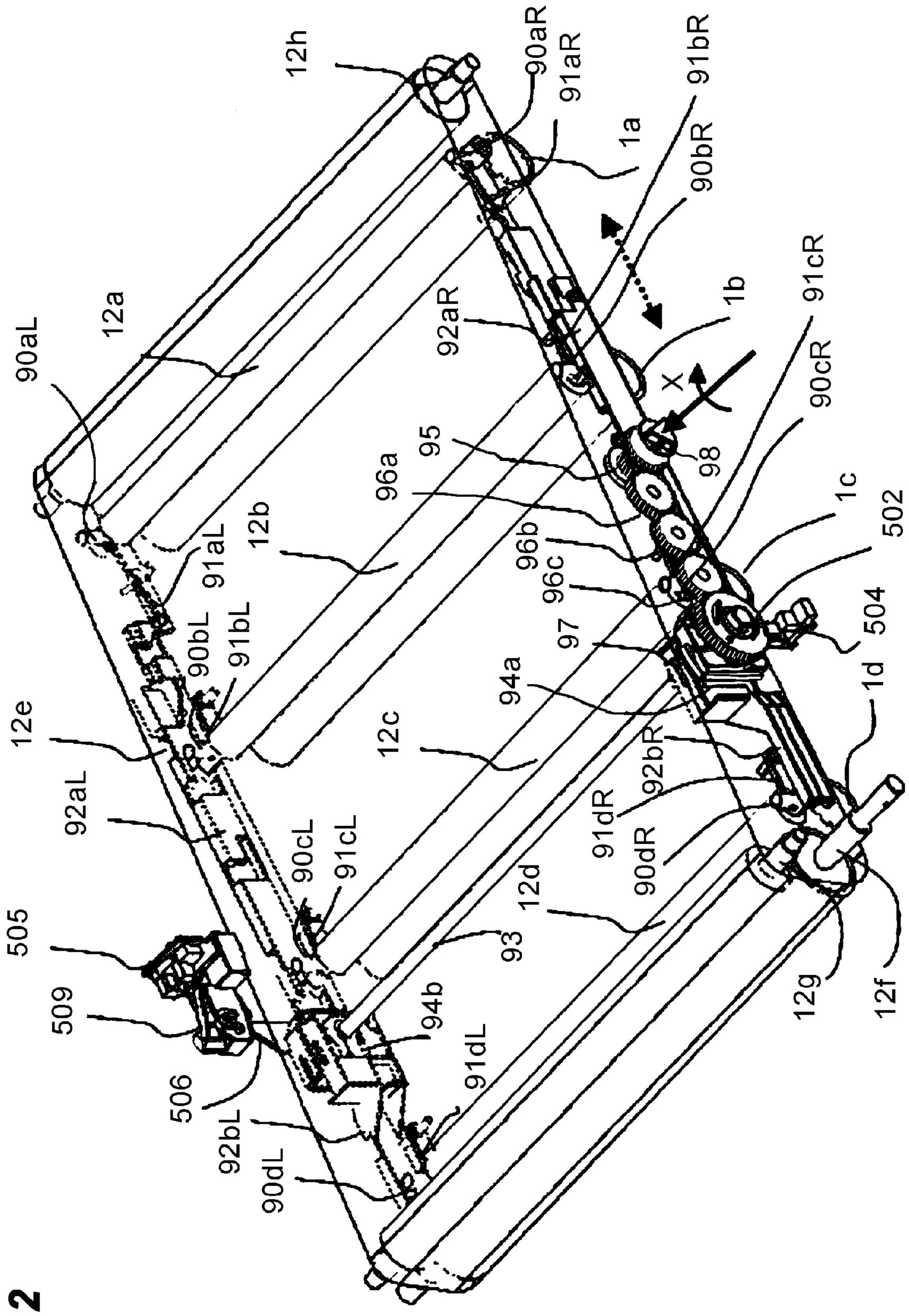
12h
90aR
91aR
1a
91bR
90bR
12a
90aL
92aR
1b
91cR
90cR
X
96a
95
98
1c
502
12b
91aL
90bL
91bL
96b
96c
97
504
94a
1d
12e
92aL
12c
92bR
91dR
90cL
91cL
90dR
12d
505
93
509
94b
91dL
506
92bL
90dL
12g
12f

FIG. 2

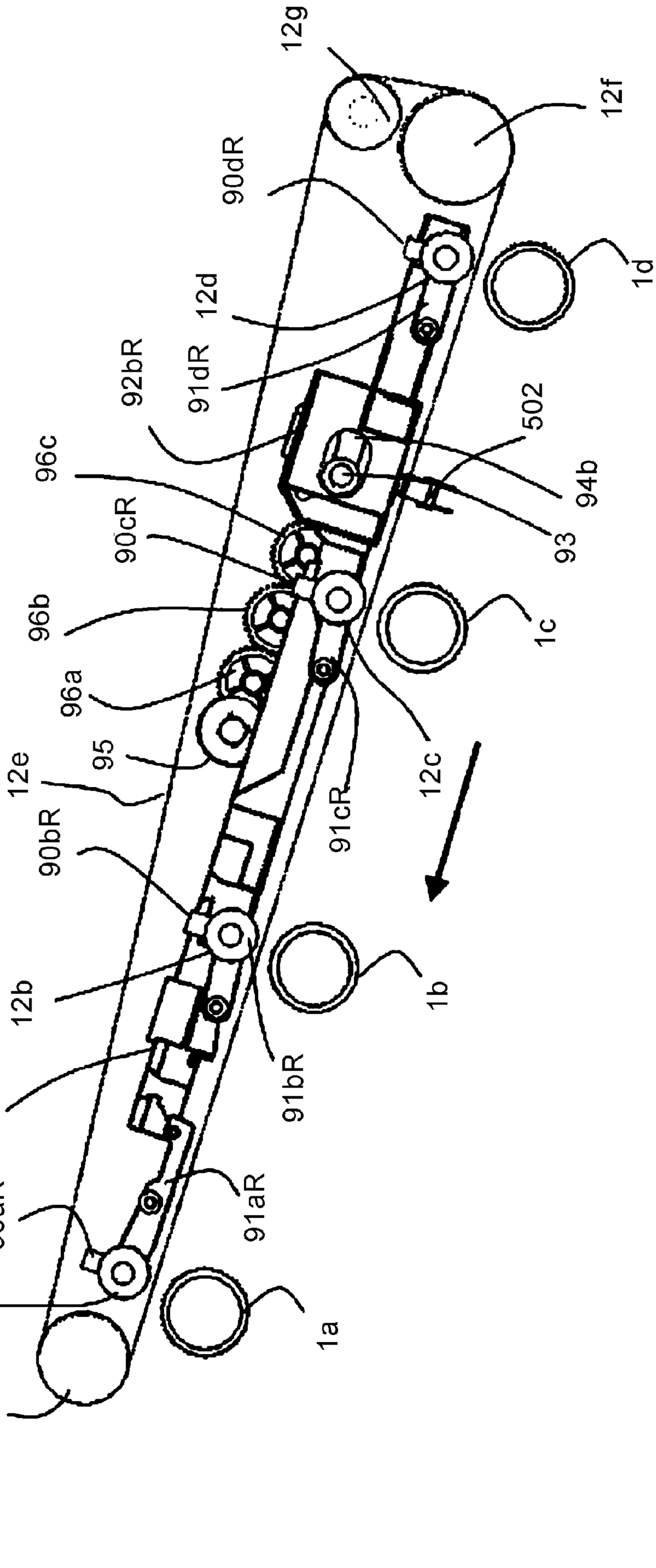
12g
12f
90dR
1d
12d
92bR
91dR
502
96c
94b
90cR
93
96b
1c
96a
95
12e
12c
90bR
91cR
12b
92aR
91bR
1b
90aR
91aR
12a
1a
12h

FIG. 3

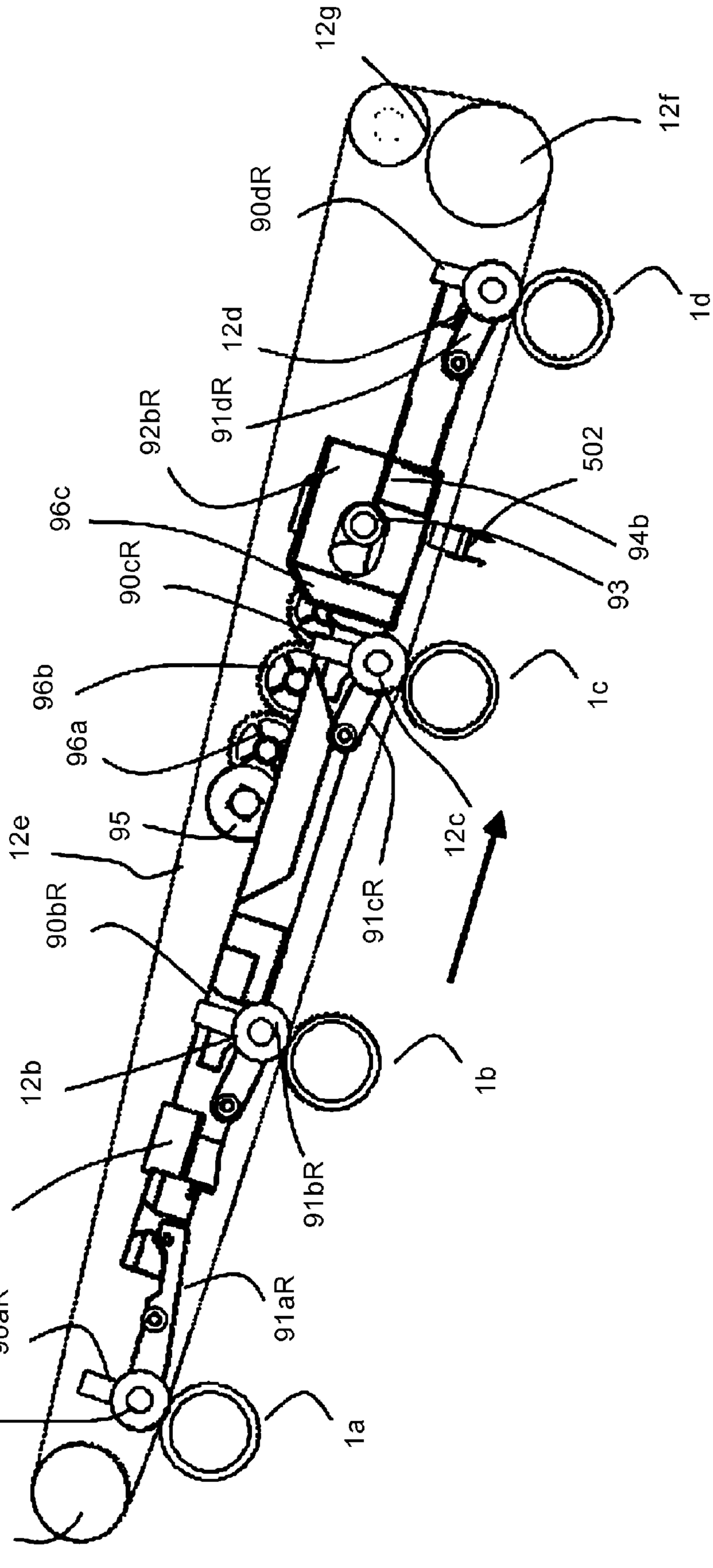
12g
12f
90dR
1d
12d
91dR
92bR
502
96c
90cR
94b
93
96b
1c
96a
95
12e
12c
90bR
91cR
12b
1b
92aR
91bR
90aR
91aR
12a
1a
12h

FIG. 4

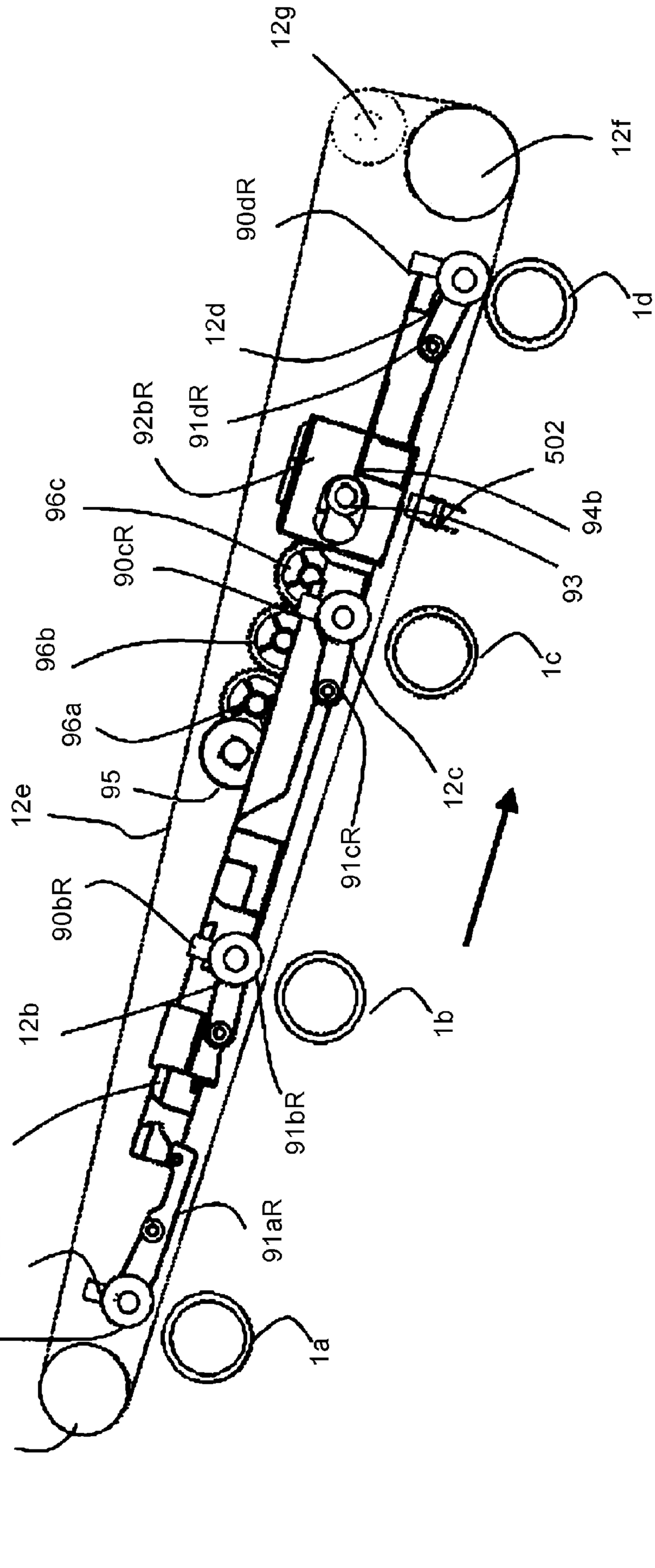
12g
12f
90dR
1d
12d
92bR
91dR
502
96c
94b
90cR
93
96b
1c
96a
95
12e
12c
91cR
90bR
12b
1b
92aR
91bR
90aR
91aR
12a
1a
12h

FIG. 5

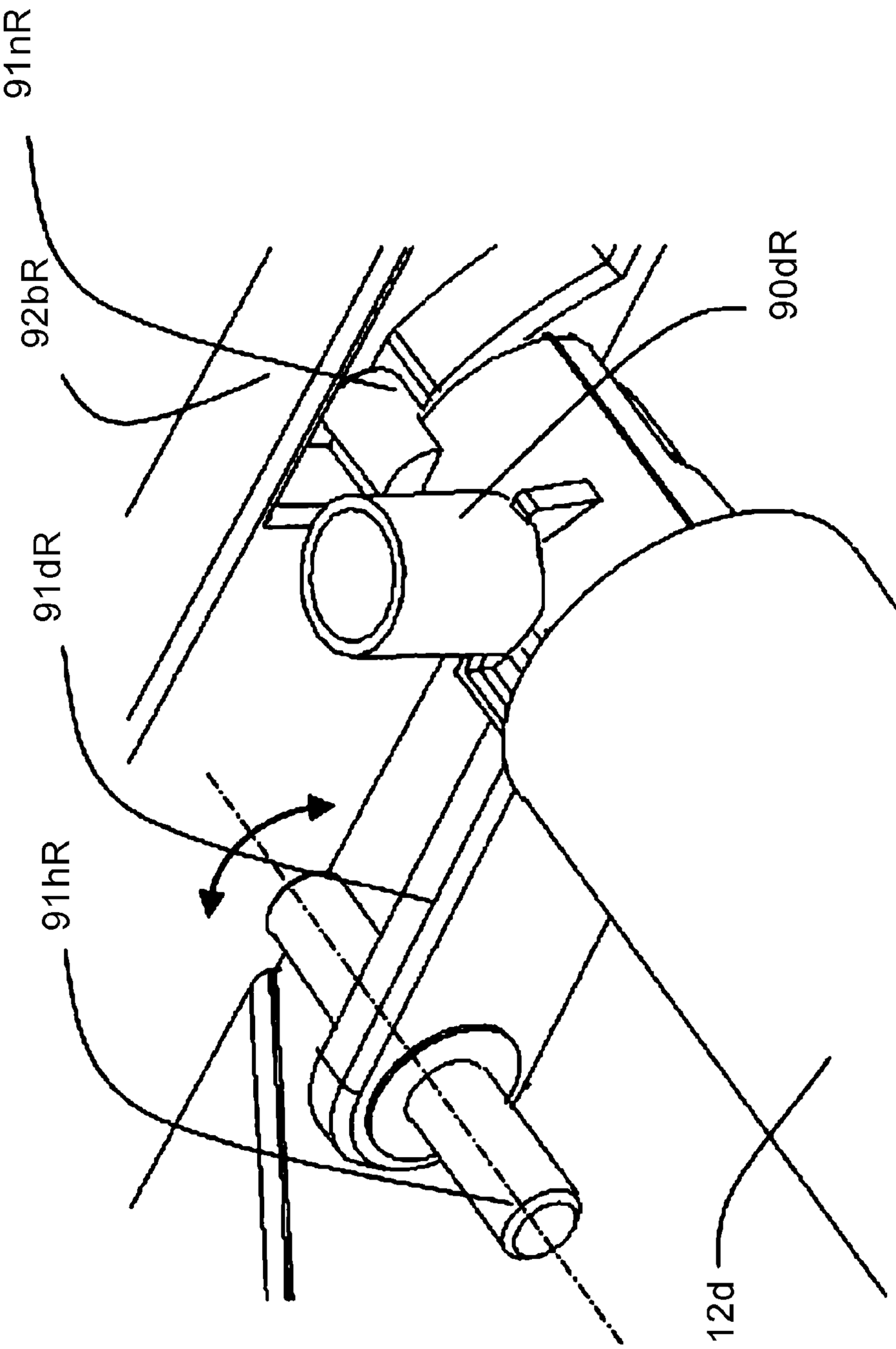

FIG. 6

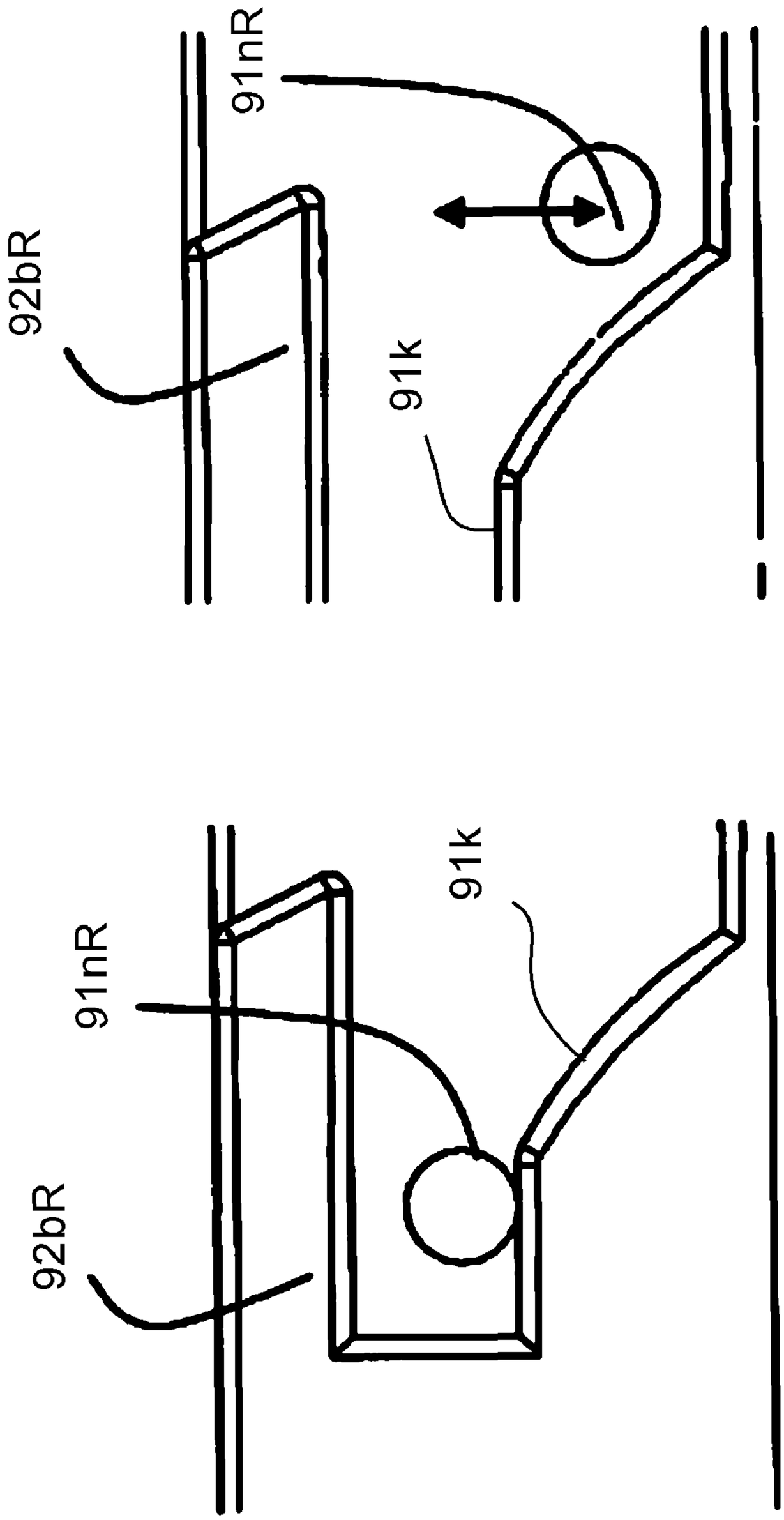

FIG. 7B

FIG. 7A

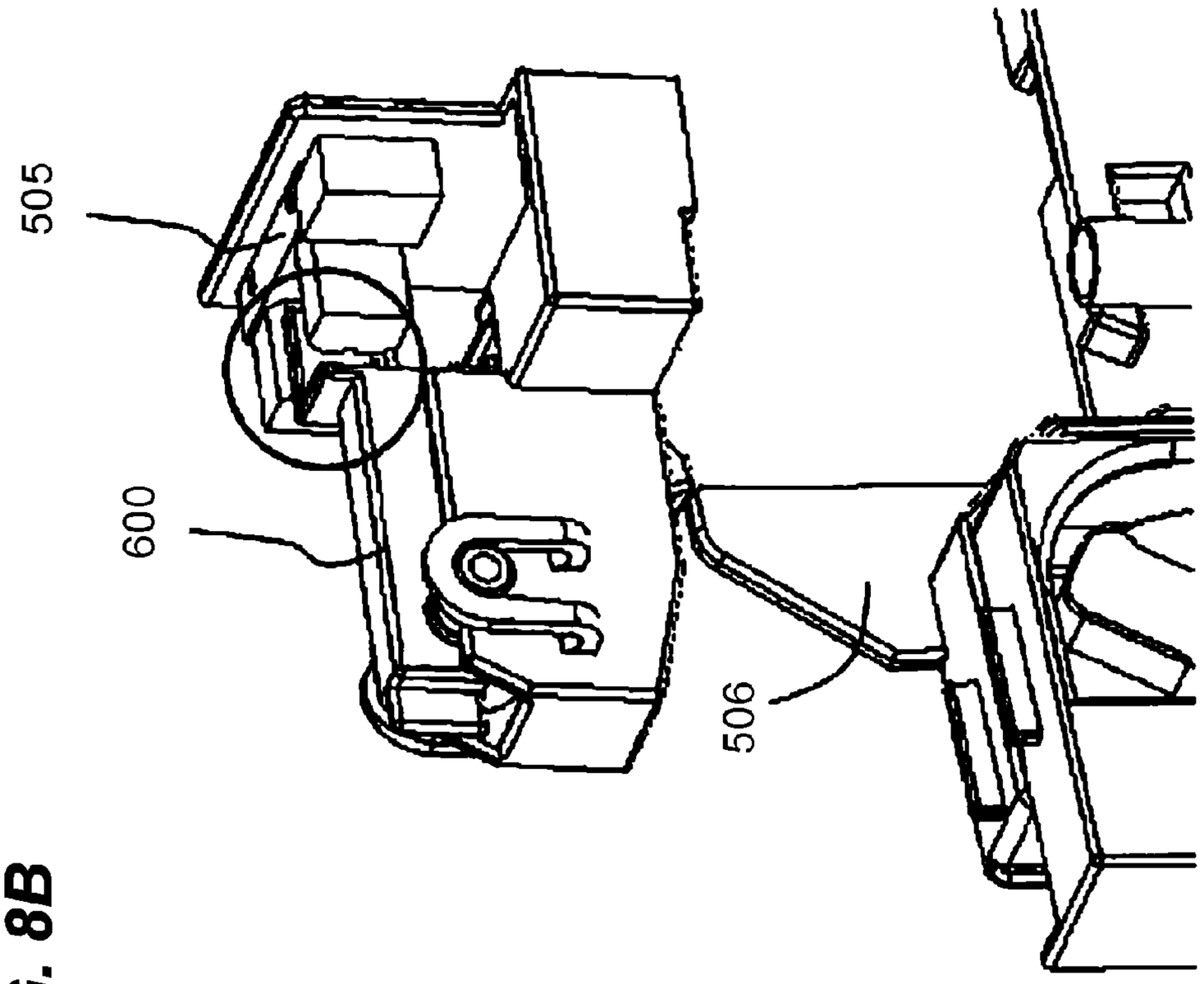

FIG. 8B

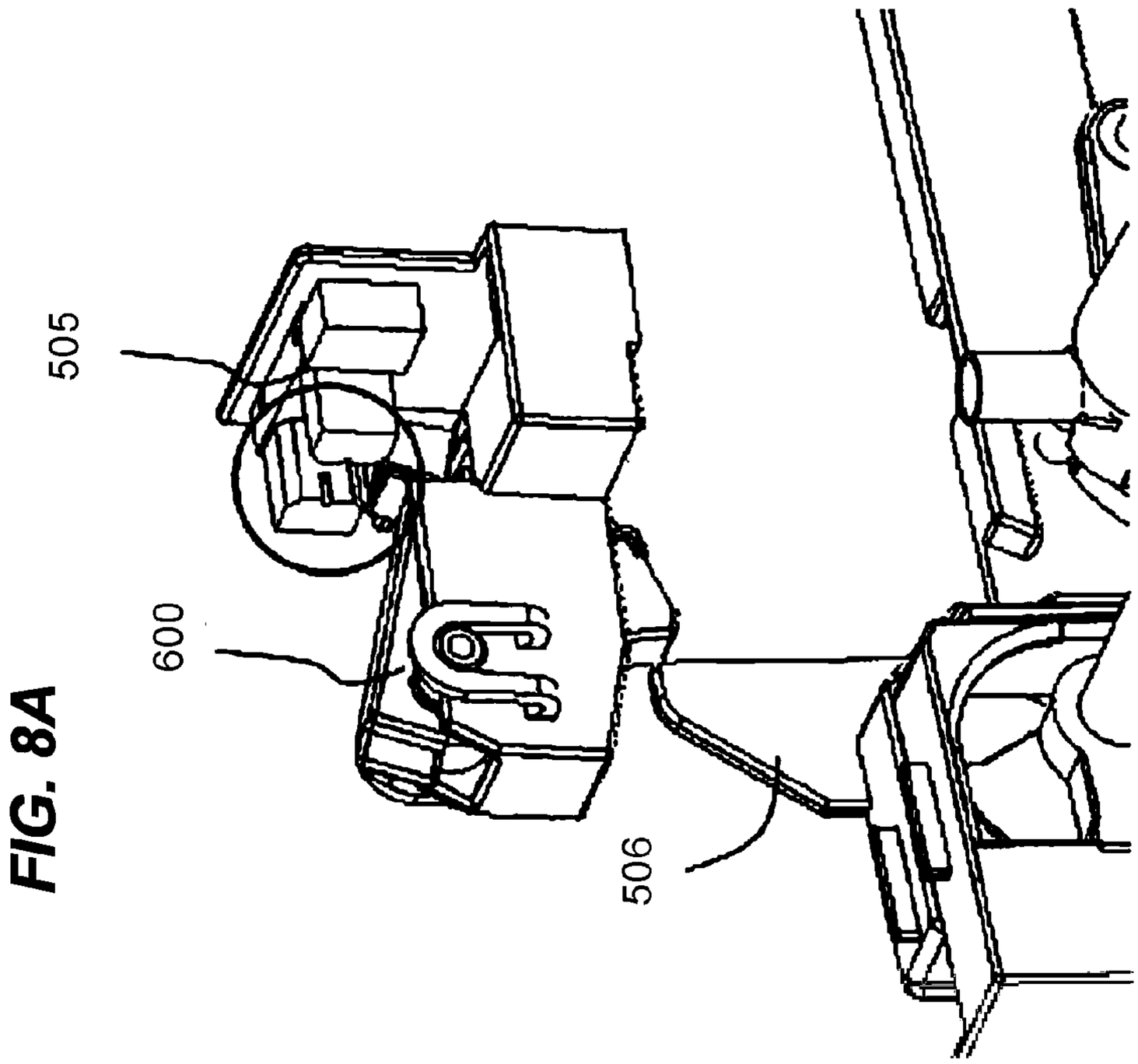

FIG. 8A

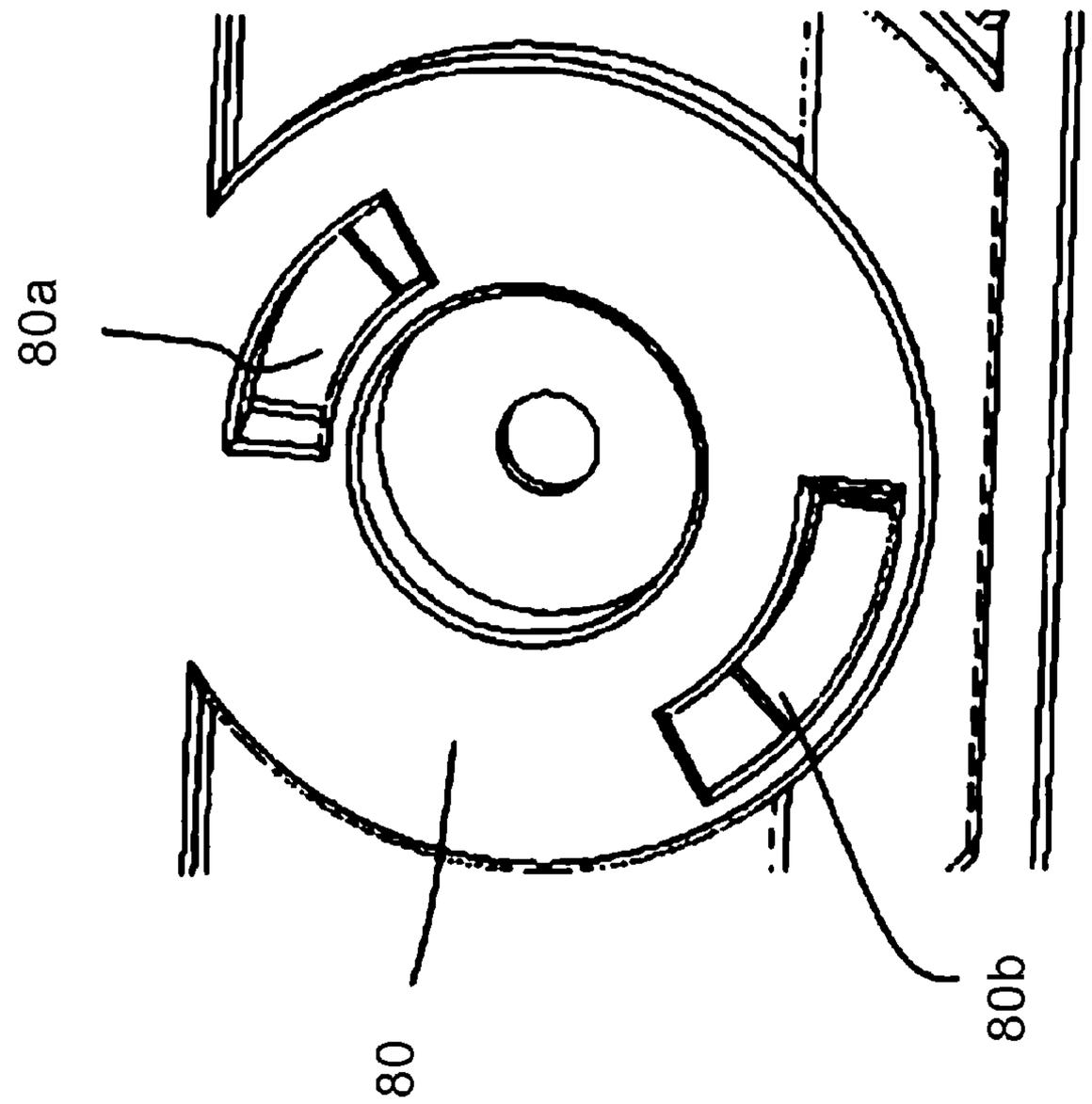

FIG. 9B

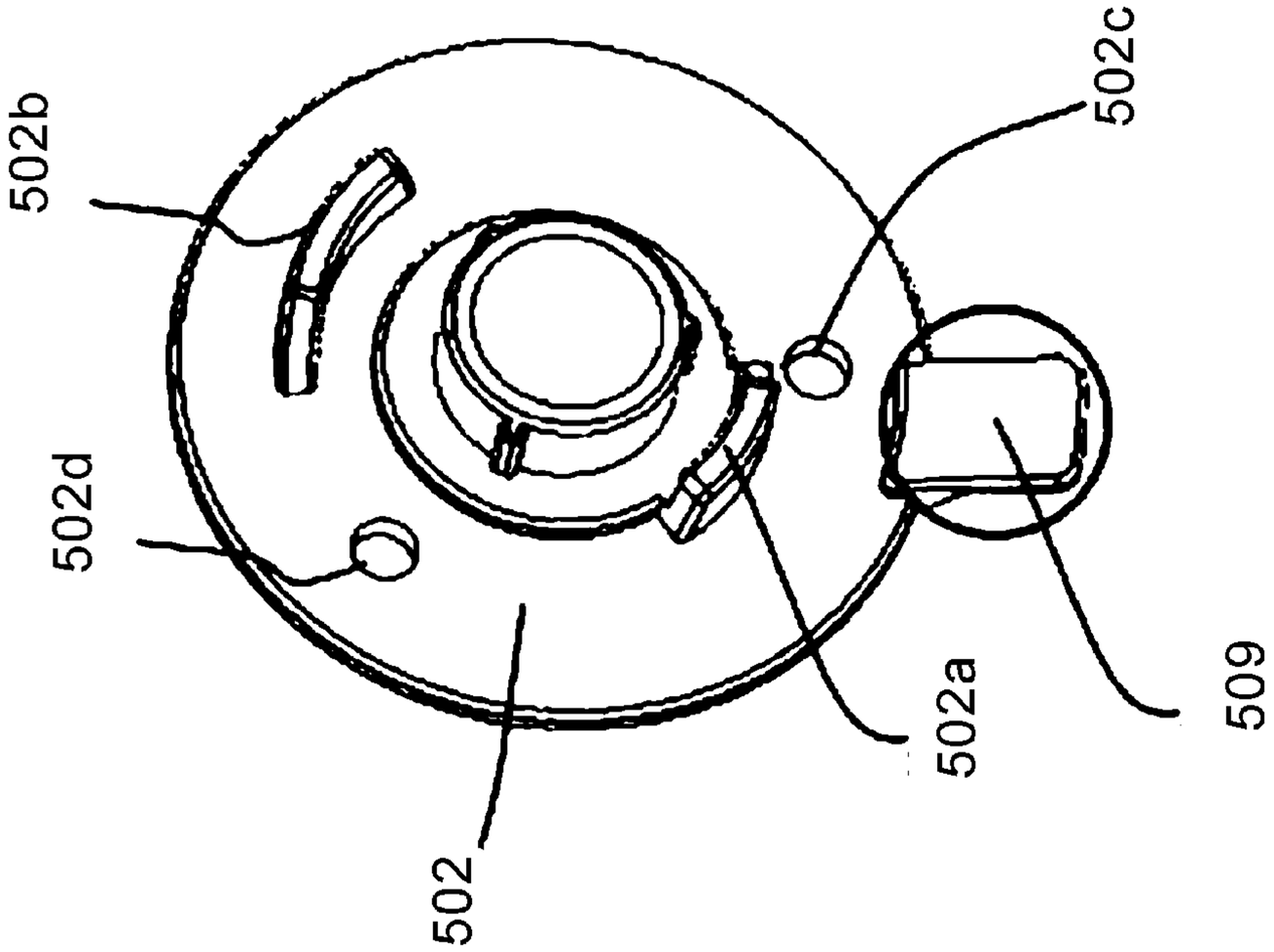

FIG. 9A

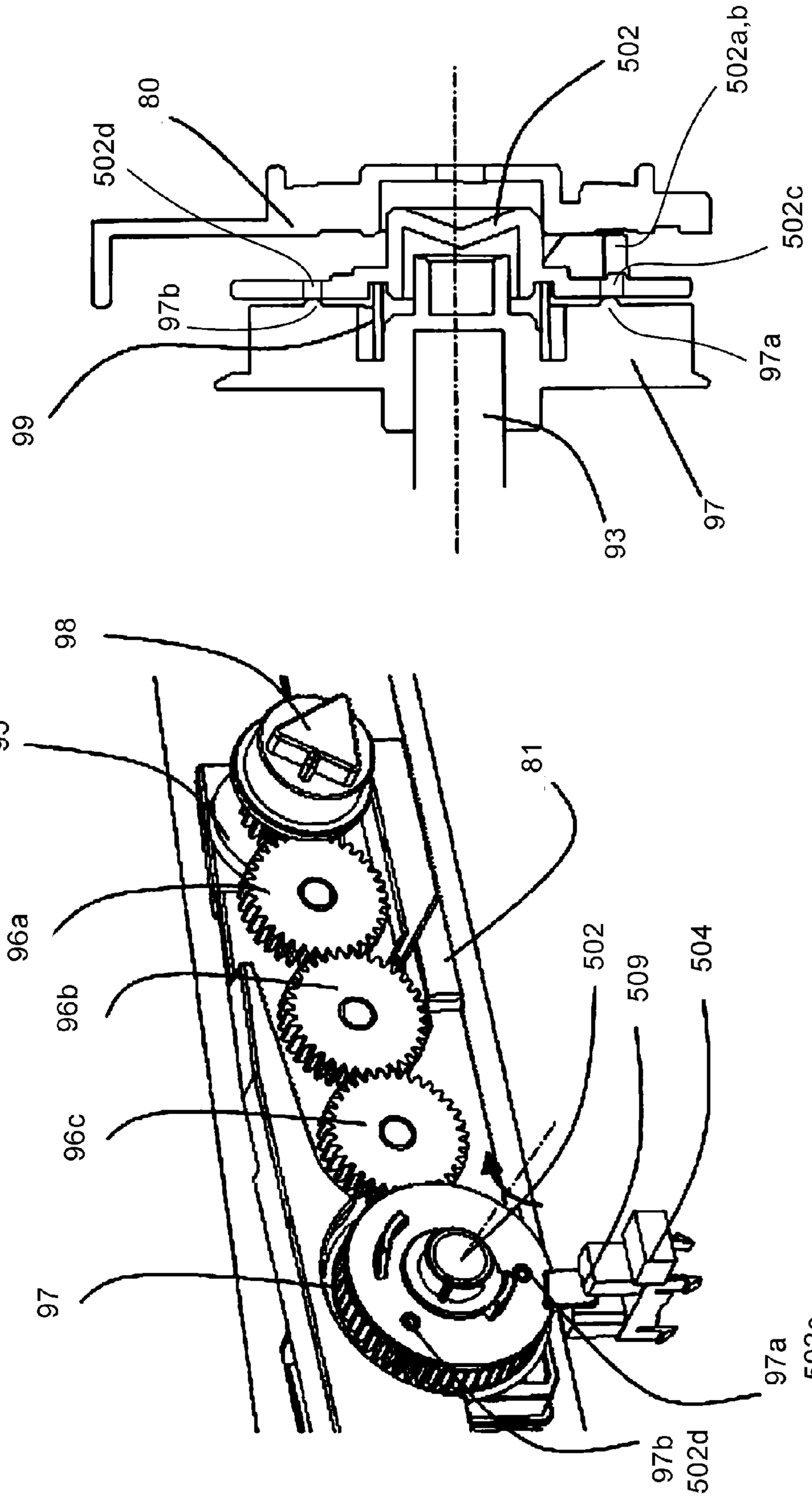

FIG. 10B

FIG. 10A

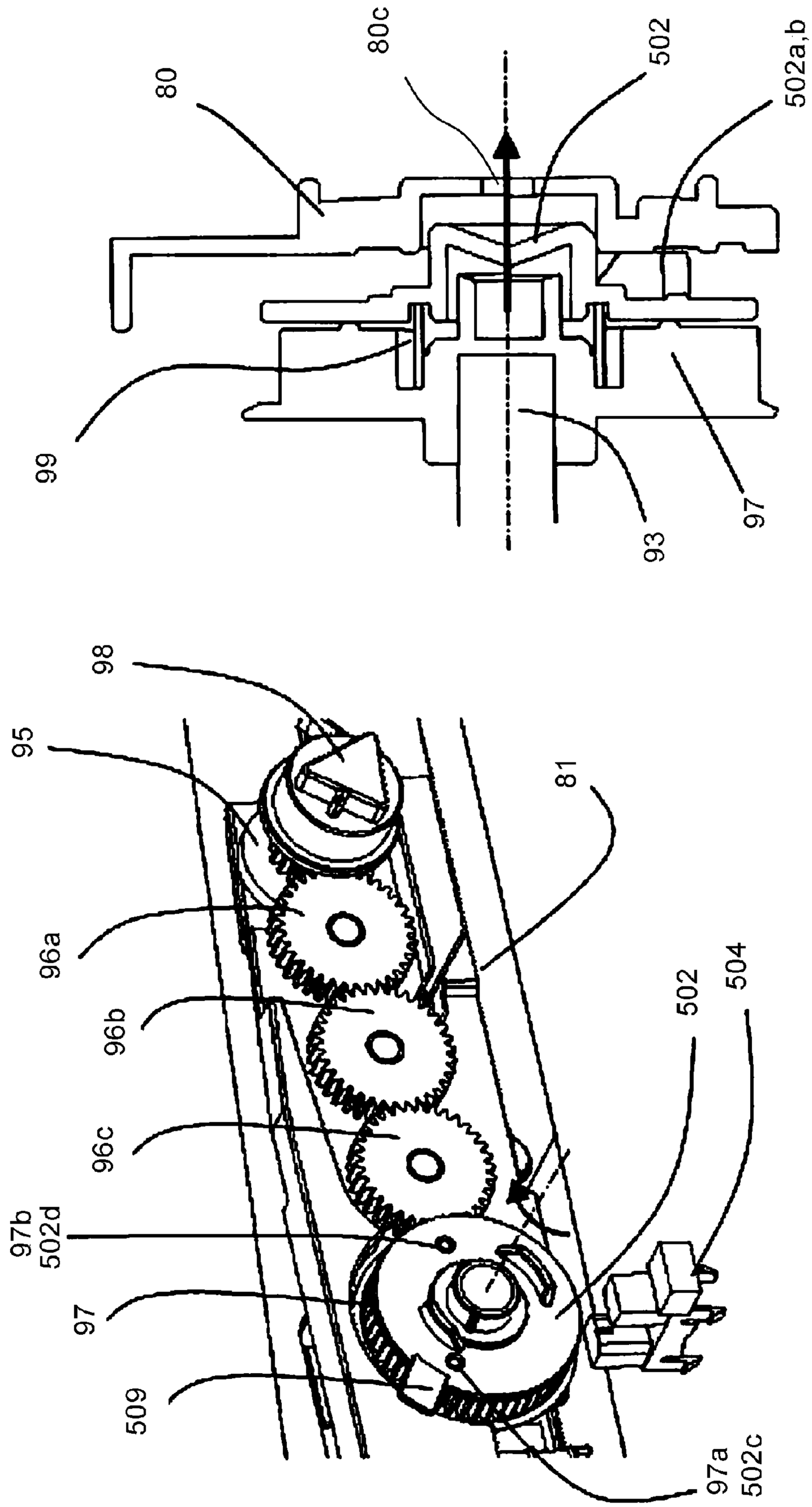
80c
502
502a,b
80
99
93
97
98
95
81
96a
96b
96c
502
504
97b
502d
97
509
97a
502c

FIG. 11A

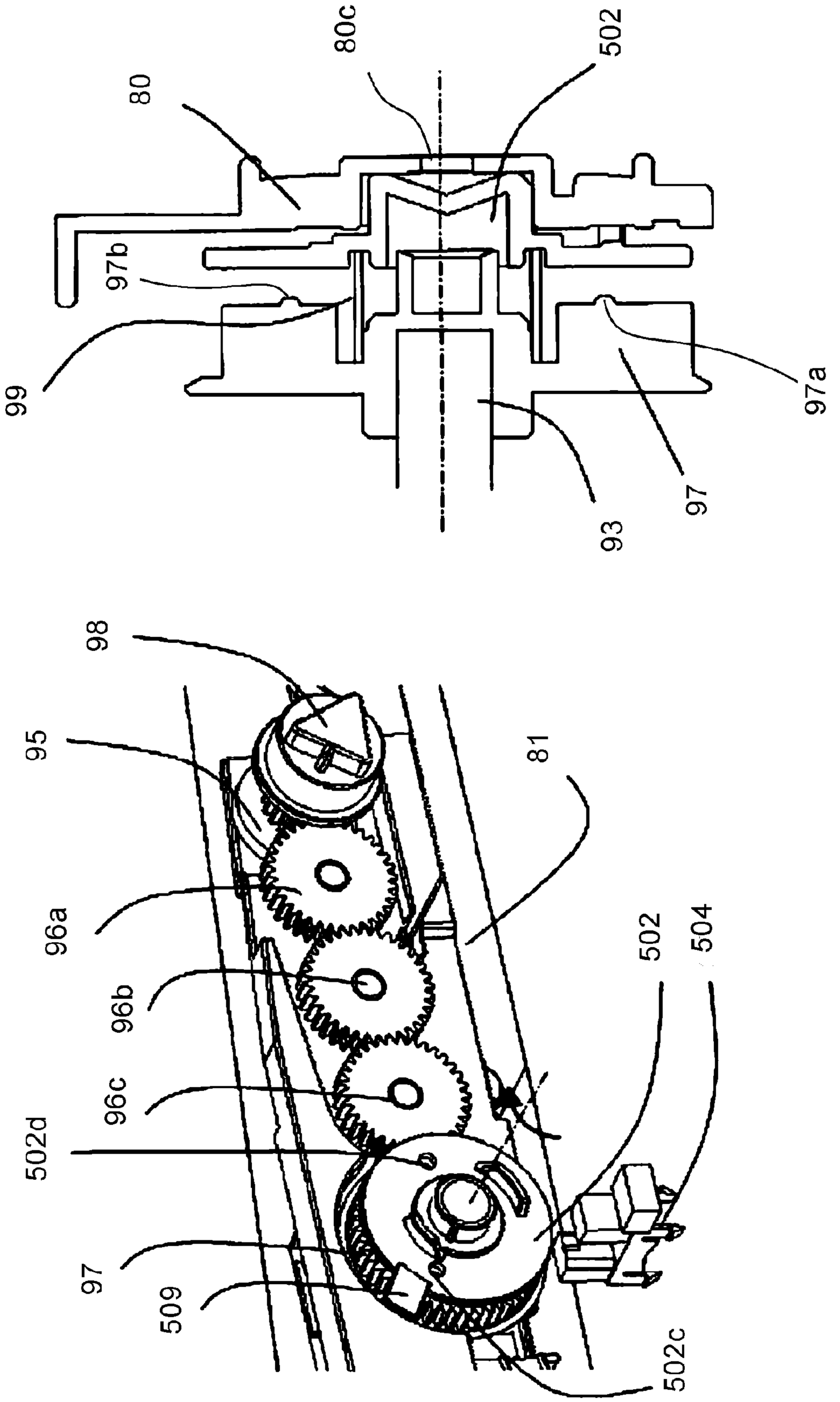

FIG. 12A

FIG. 12B

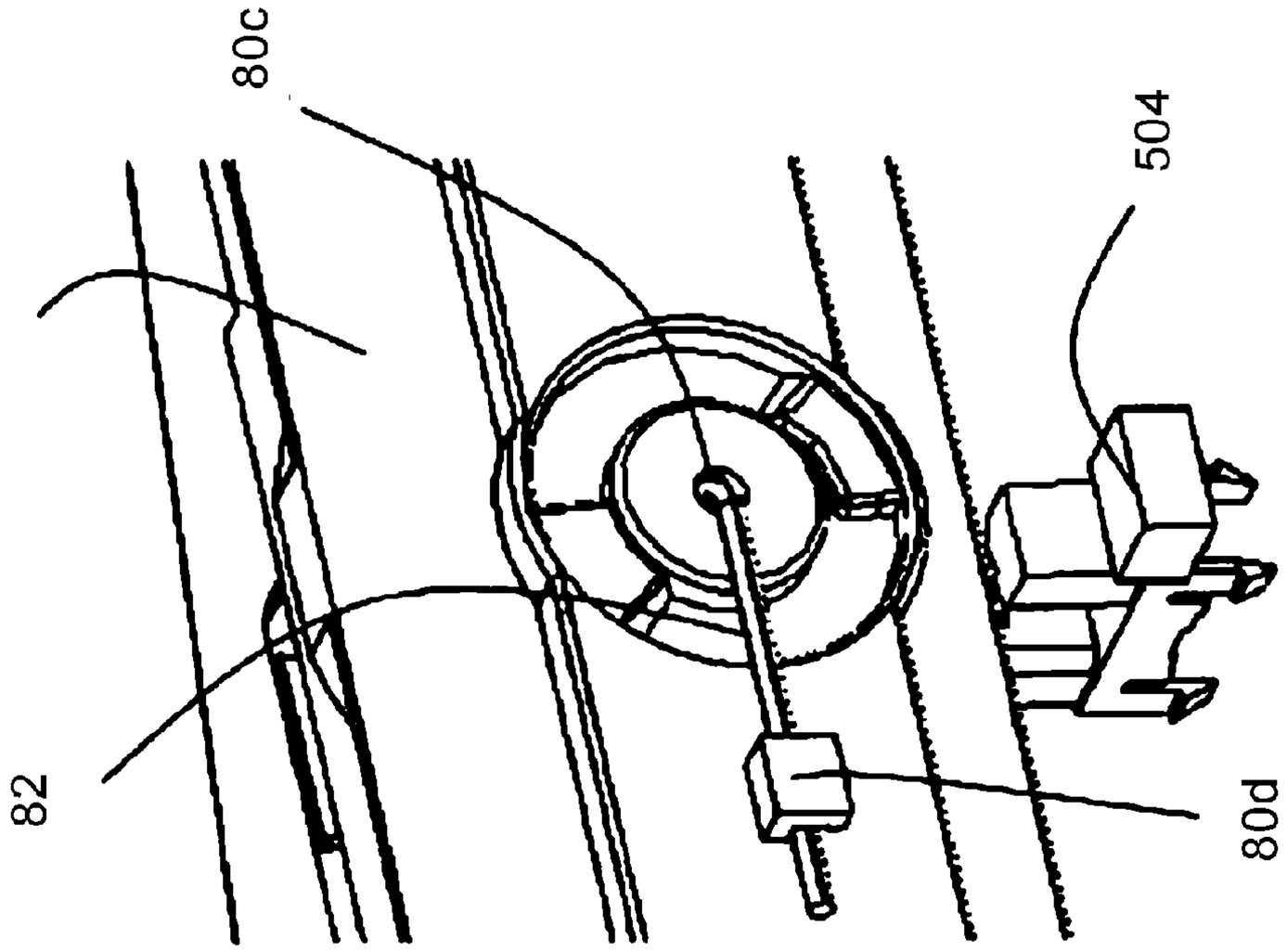

FIG. 13B

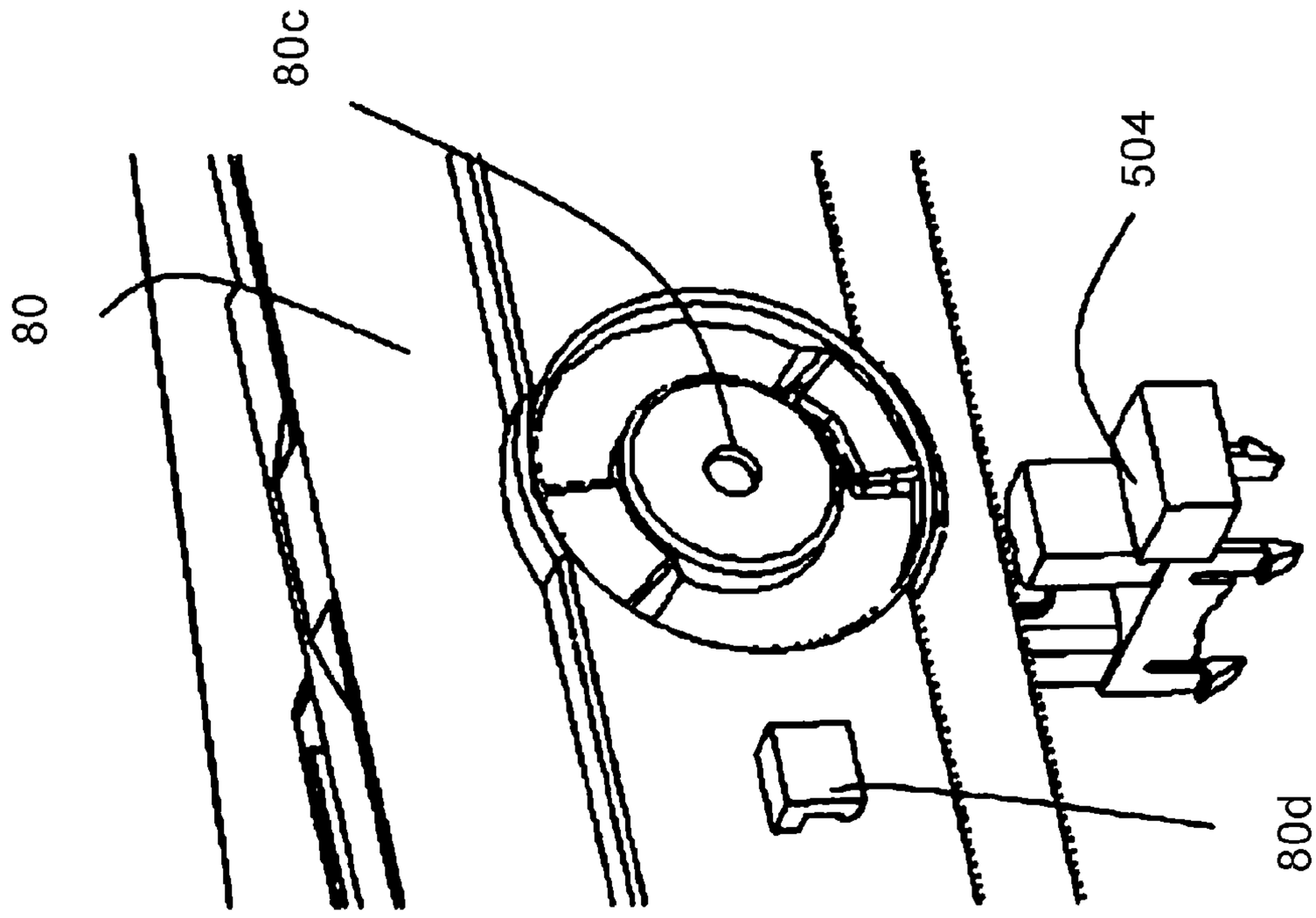

FIG. 13A

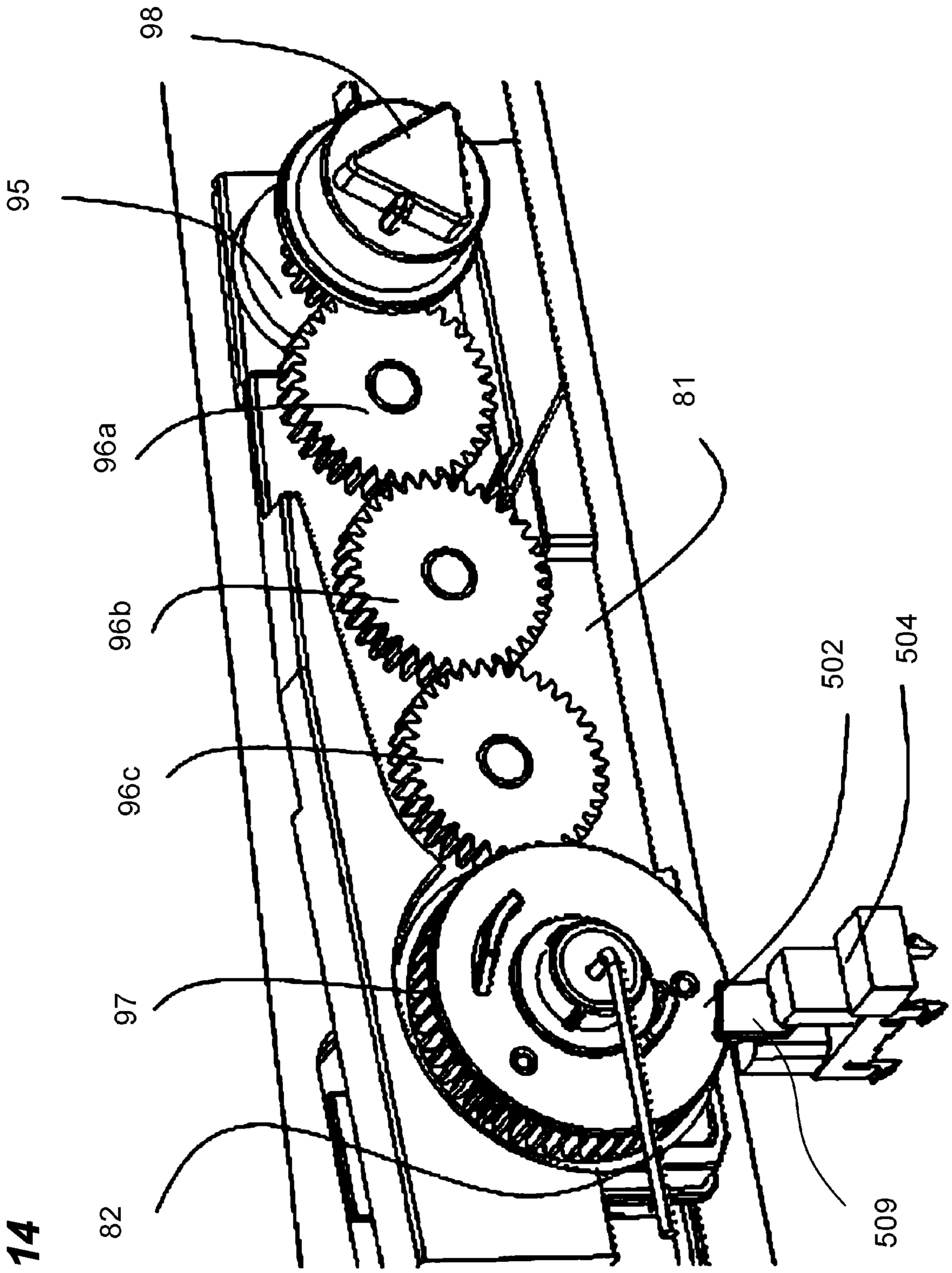

FIG. 14

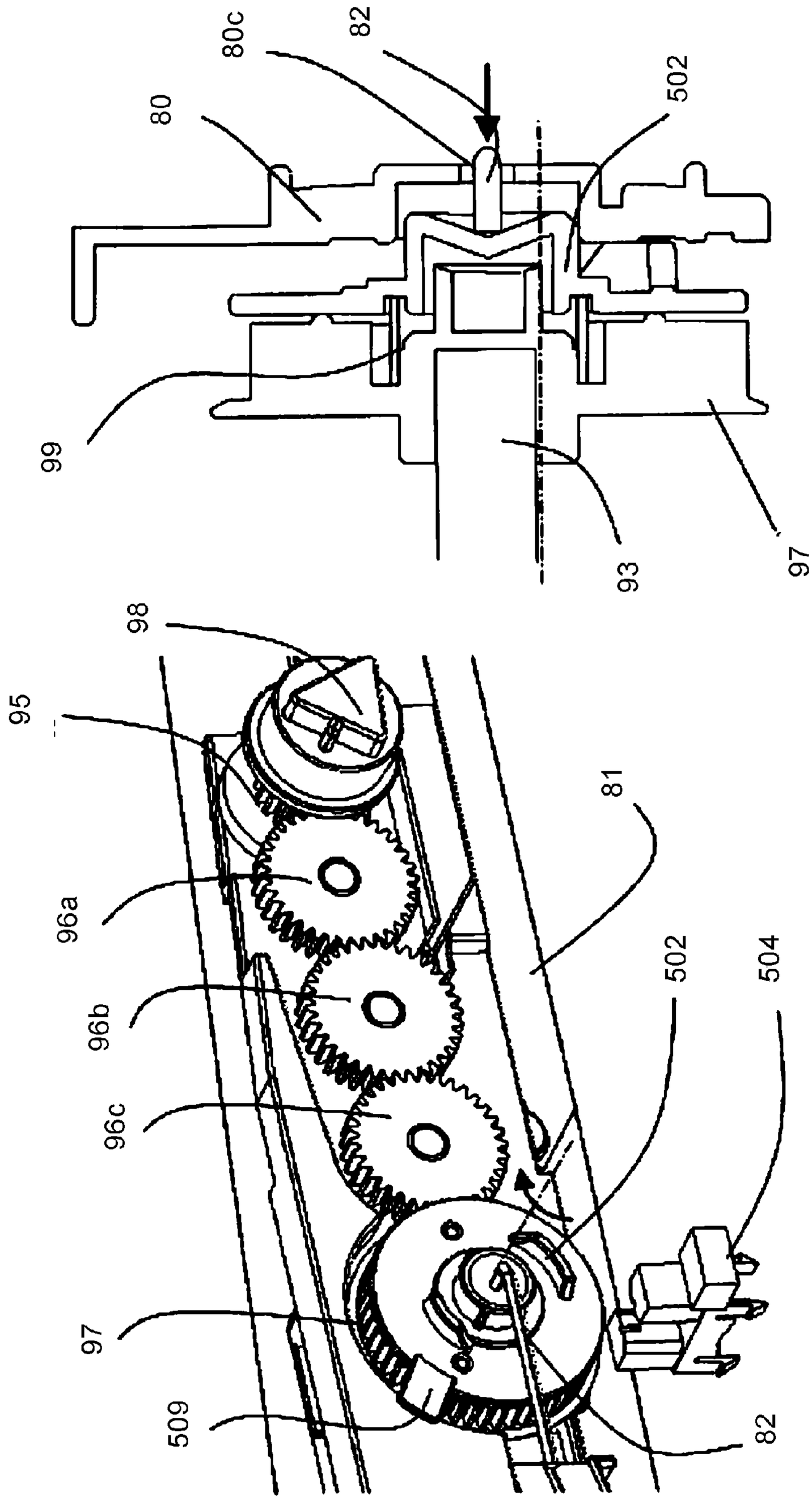

FIG. 15A

FIG. 16

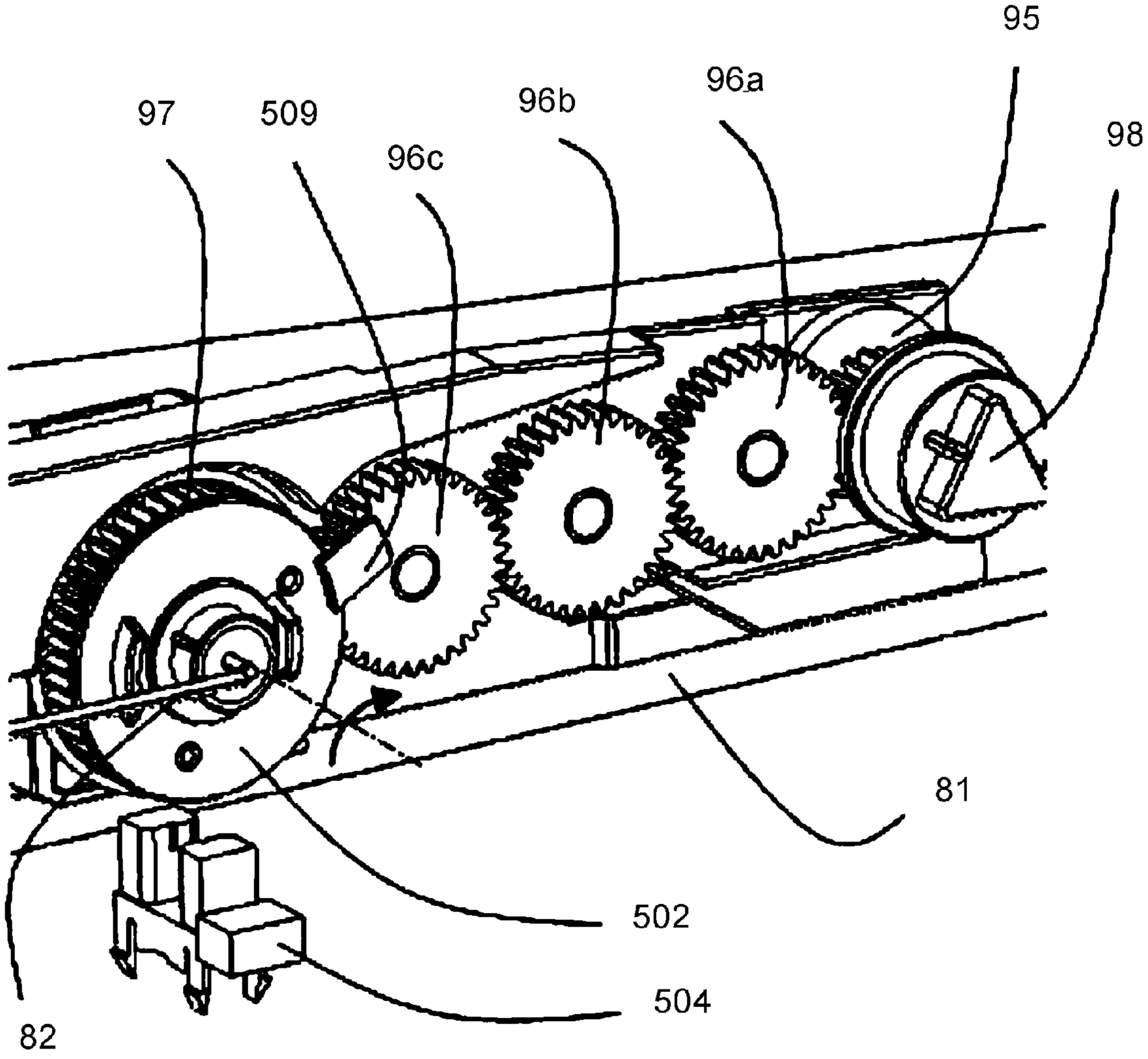

FIG. 17

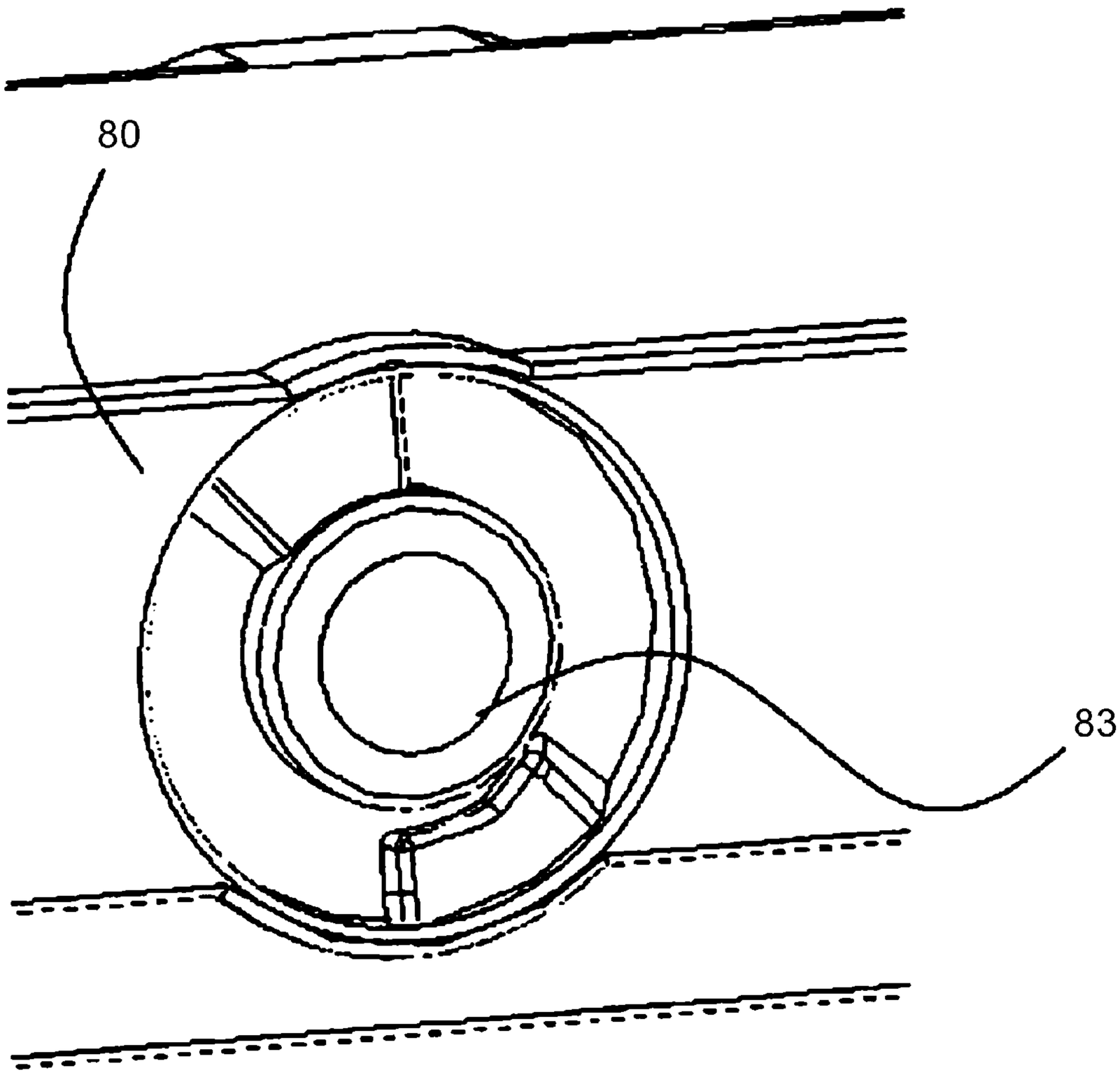

FIG. 18

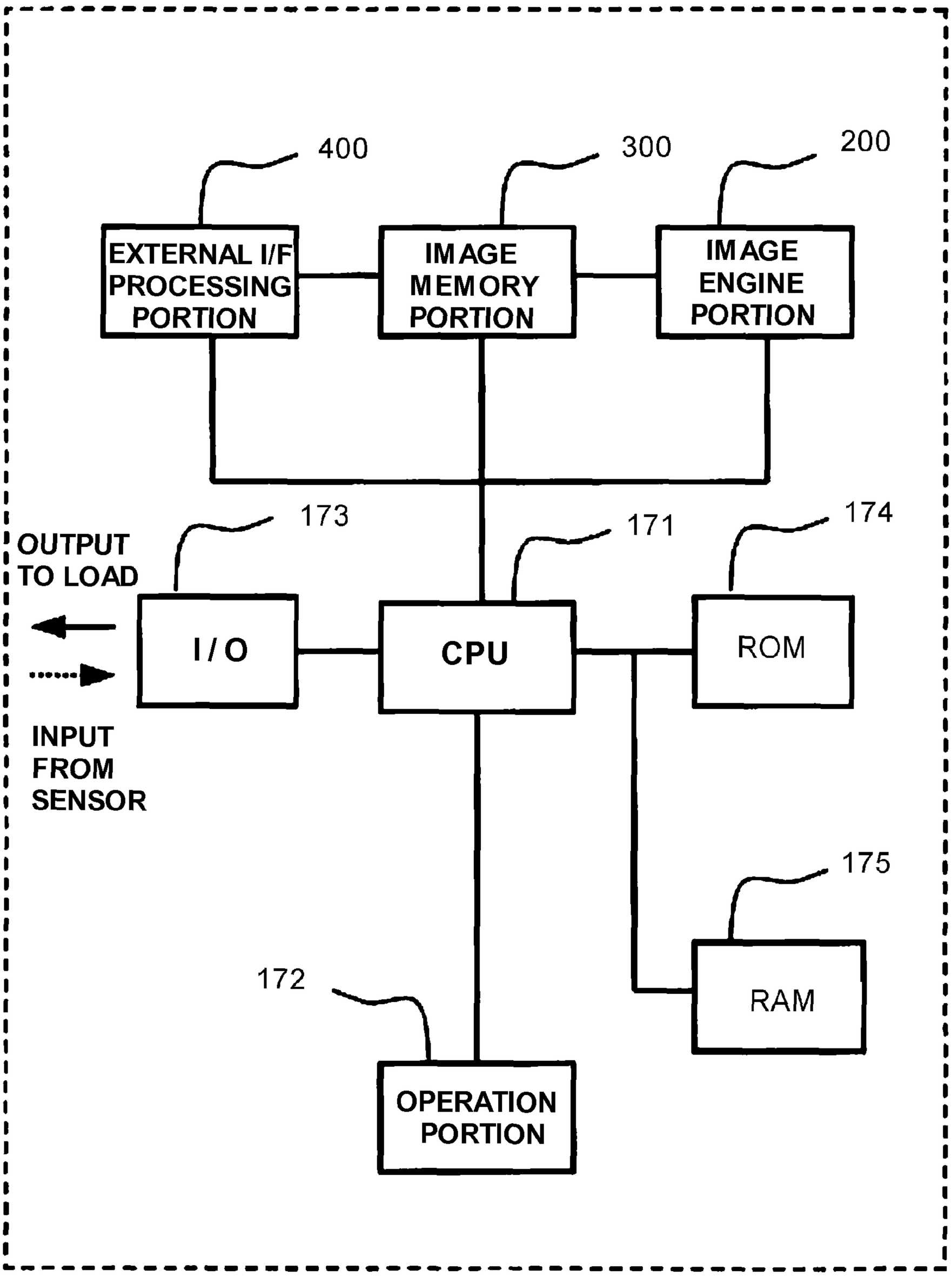
400
300
200
EXTERNAL I/F PROCESSING PORTION
IMAGE MEMORY PORTION
IMAGE ENGINE PORTION
173
171
174
OUTPUT TO LOAD
I/O
CPU
ROM
INPUT FROM SENSOR
175
RAM
172
OPERATION PORTION

FIG. 19

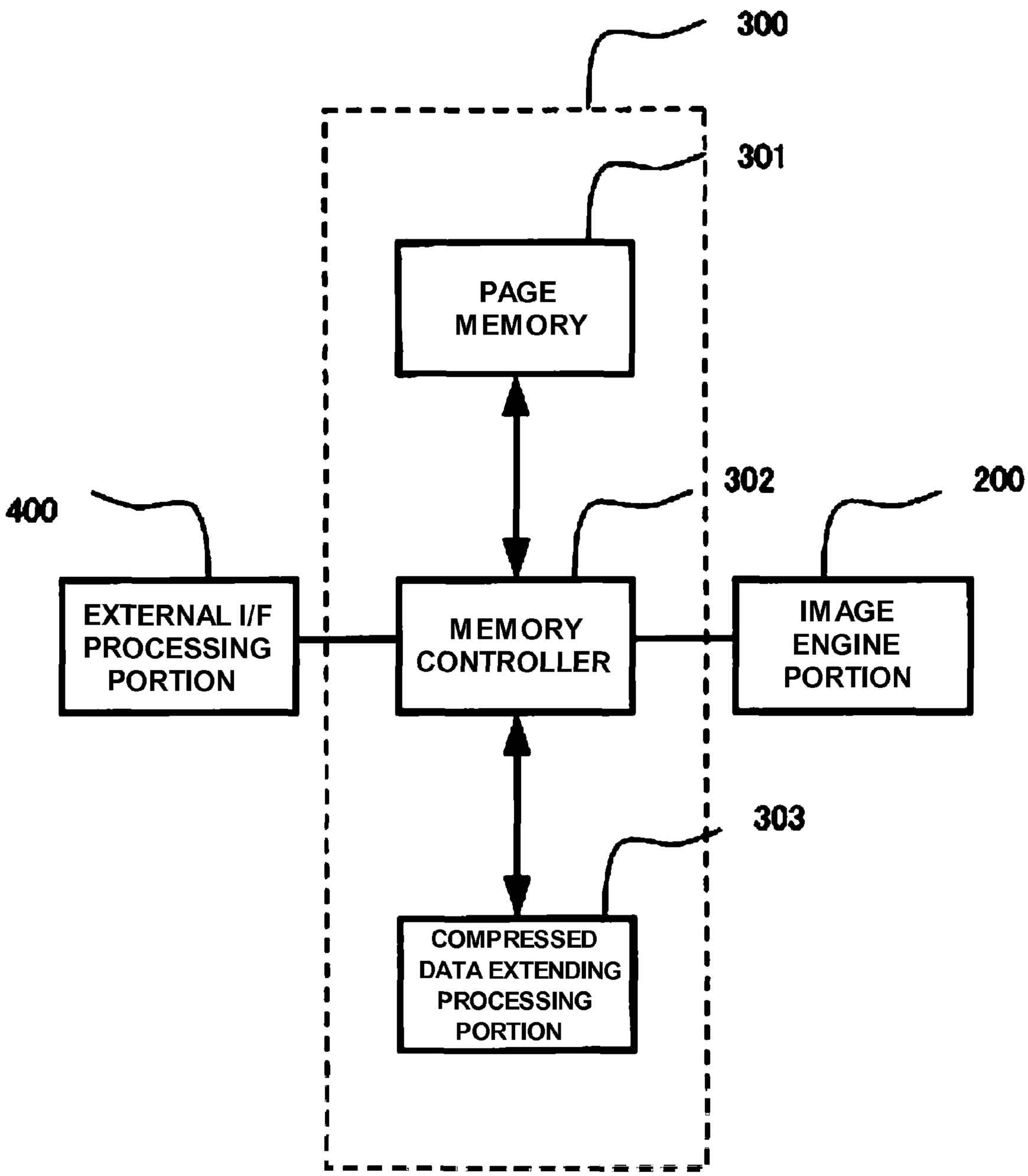
300
301
PAGE MEMORY
302
200
400
EXTERNAL I/F PROCESSING PORTION
MEMORY CONTROLLER
IMAGE ENGINE PORTION
303
COMPRESSED DATA EXTENDING PROCESSING PORTION

FIG. 20

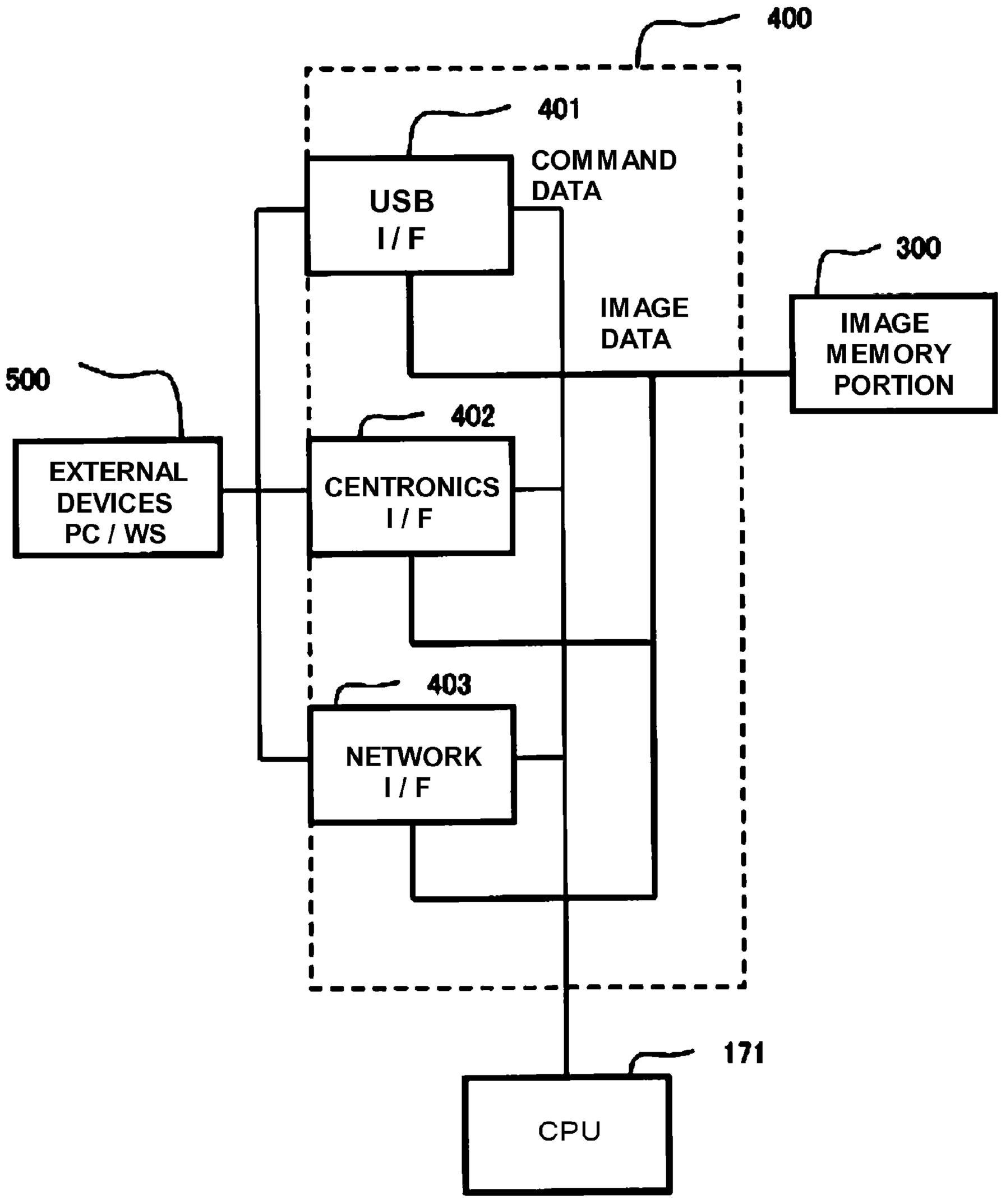
400
401
USB
I / F
COMMAND
DATA
300
IMAGE
DATA
IMAGE
MEMORY
PORTION
500
EXTERNAL
DEVICES
PC / WS
402
CENTRONICS
I / F
403
NETWORK
I / F
171
CPU

FIG. 21

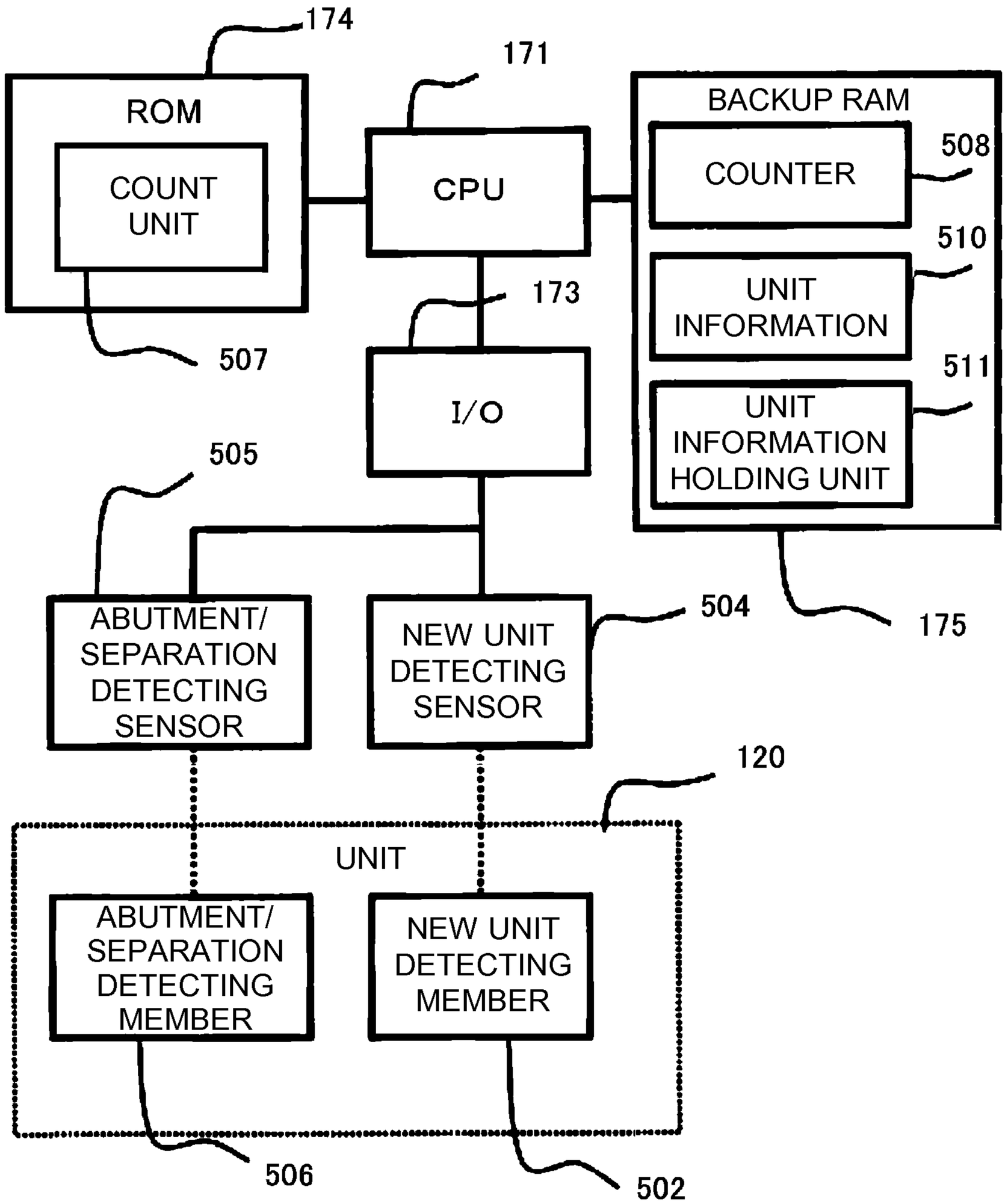
174
171
ROM
COUNT UNIT
CPU
BACKUP RAM
COUNTER
508
510
UNIT INFORMATION
511
UNIT INFORMATION HOLDING UNIT
173
507
I/O
505
ABUTMENT/ SEPARATION DETECTING SENSOR
NEW UNIT DETECTING SENSOR
504
175
120
UNIT
ABUTMENT/ SEPARATION DETECTING MEMBER
NEW UNIT DETECTING MEMBER
506
502

FIG. 22

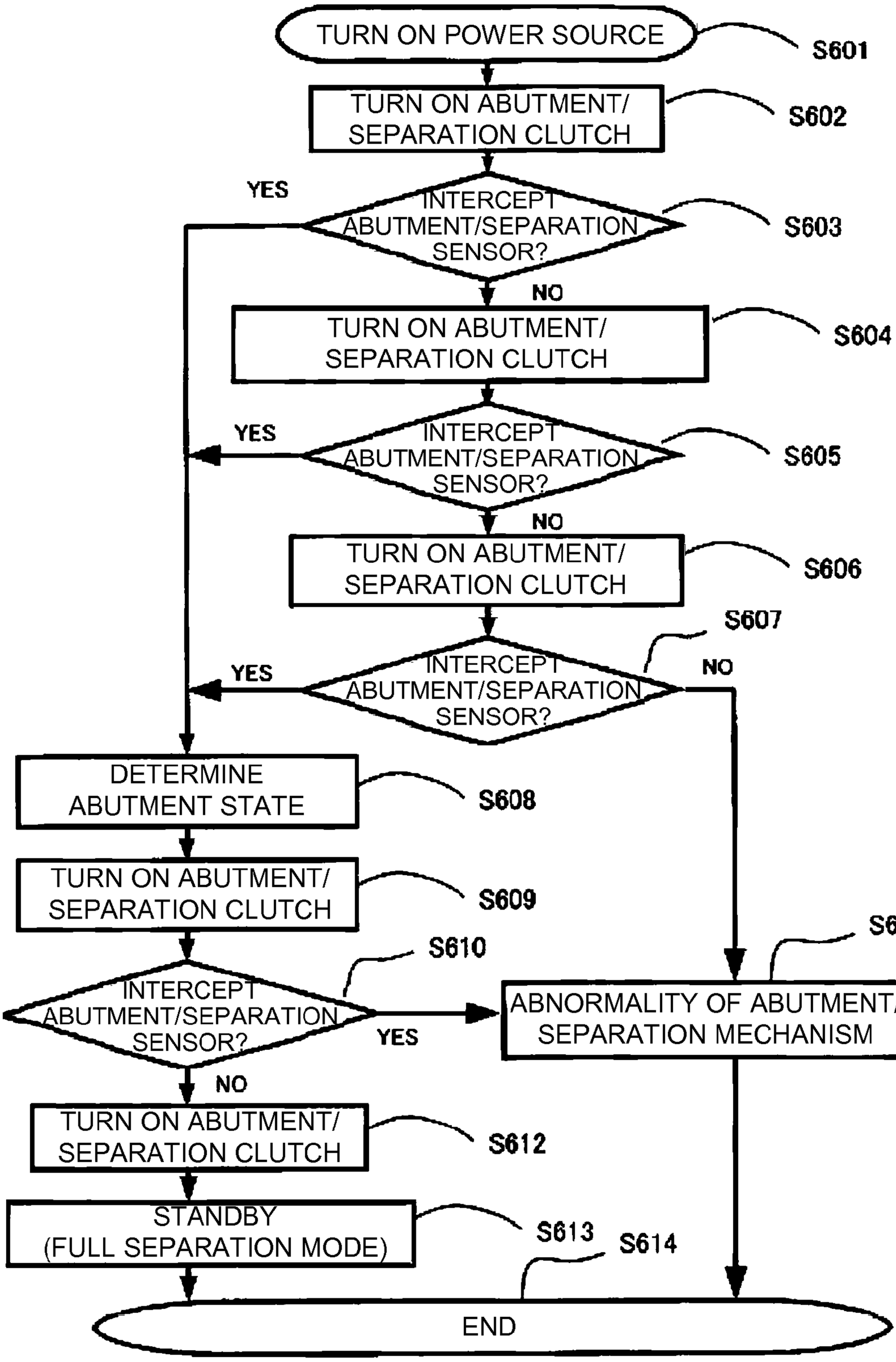
TURN ON POWER SOURCE
S601
TURN ON ABUTMENT/ SEPARATION CLUTCH
S602
YES
INTERCEPT ABUTMENT/SEPARATION SENSOR?
S603
NO
TURN ON ABUTMENT/ SEPARATION CLUTCH
S604
YES
INTERCEPT ABUTMENT/SEPARATION SENSOR?
S605
NO
TURN ON ABUTMENT/ SEPARATION CLUTCH
S606
S607
YES
INTERCEPT ABUTMENT/SEPARATION SENSOR?
NO
DETERMINE ABUTMENT STATE
S608
TURN ON ABUTMENT/ SEPARATION CLUTCH
S609
S610
INTERCEPT ABUTMENT/SEPARATION SENSOR?
YES
S611
ABNORMALITY OF ABUTMENT/ SEPARATION MECHANISM
NO
TURN ON ABUTMENT/ SEPARATION CLUTCH
S612
STANDBY (FULL SEPARATION MODE)
S613
S614
END

FIG. 23

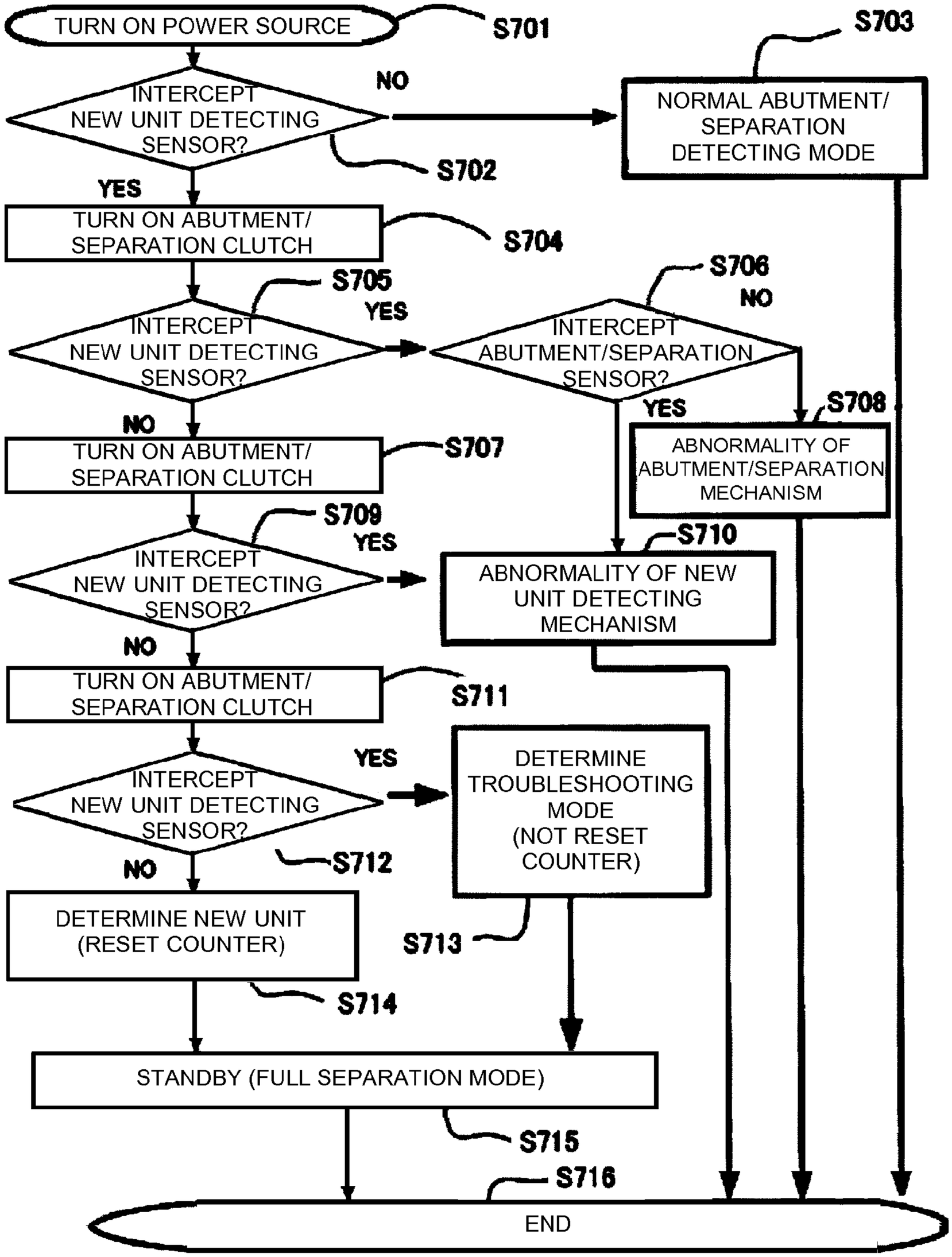
TURN ON POWER SOURCE
S701
INTERCEPT NEW UNIT DETECTING SENSOR?
NO
S702
YES
TURN ON ABUTMENT/ SEPARATION CLUTCH
S704
S703
NORMAL ABUTMENT/ SEPARATION DETECTING MODE
S705
INTERCEPT NEW UNIT DETECTING SENSOR?
YES
S706
INTERCEPT ABUTMENT/SEPARATION SENSOR?
NO
YES
S708
ABNORMALITY OF ABUTMENT/SEPARATION MECHANISM
NO
TURN ON ABUTMENT/ SEPARATION CLUTCH
S707
S709
INTERCEPT NEW UNIT DETECTING SENSOR?
YES
S710
ABNORMALITY OF NEW UNIT DETECTING MECHANISM
NO
TURN ON ABUTMENT/ SEPARATION CLUTCH
S711
INTERCEPT NEW UNIT DETECTING SENSOR?
YES
S712
DETERMINE TROUBLESHOOTING MODE (NOT RESET COUNTER)
NO
DETERMINE NEW UNIT (RESET COUNTER)
S713
S714
STANDBY (FULL SEPARATION MODE)
S715
S716
END

IMAGE FORMING APPARATUS

This is a division of U.S. patent application Ser. No. 12/426,521, filed Apr. 20, 2009.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an image forming apparatus utilizing an electrophotographic system such as a copying machine or a facsimile and, more particularly, to an image forming apparatus having a unit detachably attachable to a main body of the apparatus and the unit.

2. Description of the Related Art

There has been conventionally an image forming apparatus utilizing an electrophotographic system in which a photosensitive drum, a cleaner, a development device, and the like disposed around the drum are unified as a so-called process cartridge, the unit being replaceable with respect to a main body of the image forming apparatus.

Like the process cartridge, a transfer belt unit constituted of a transfer roller and a belt member, which are adapted to transfer a toner image formed on an image bearing member (e.g., a photosensitive drum and an intermediate transfer belt) onto a transfer material, and a tension roller is a consumable. Therefore, the unit needs to be replaced with a new one when its life expires.

The image forming apparatus is provided with a counter which counts the speed of the belt member or the tension roller so as to notify a user of the need to replace the unit. When the count (i.e., a use history) of the counter reaches a predetermined value, an alert indicating the need to replace the unit concerned is displayed on a display in the image forming apparatus. Upon receipt of the alert, the user can replace the unit at a proper timing.

When the old unit is replaced with a new one, it is preferable that the past use history of the old transfer belt unit be reset, and then, a transfer voltage to be applied or the like be varied according to a new transfer belt unit. At this time, the user or a serviceman resets the use history on an operation portion. However, he or she may forget such work per se, and therefore, may not appropriately reset the use history.

In view of this, it is desirable that the new unit and the old unit be distinguishably detected, thereby securing the resetting work.

In the conventional image forming apparatus, there has been proposed a method for distinguishably determining a new process cartridge and an old process cartridge based on a fuse disposed therein. In this method, the old or new process cartridge is determined by detecting the electrically conducted state of the fuse in the process cartridge installed in the main body of the apparatus. When the process cartridge is determined to be a new one, the fuse is cut by predetermined initialization.

However, as described above, in the case where the fuse is cut by the predetermined initialization when the process cartridge is determined to be the new one, there have arisen the following problems.

For example, if a malfunction occurs in the image forming apparatus, it is necessary to identify whether the malfunction is caused by the main body of the image forming apparatus or the transfer belt unit. In this way, the serviceman who is requested to repair or investigate installs a new transfer belt unit in the main body of the image forming apparatus in question, and then, confirms operation, for the purpose of the diagnosis of the cause of the malfunction.

In this case, when the new transfer belt unit is installed in the apparatus, the image forming apparatus detects that the transfer belt unit installed is a new one, and then, performs the initialization of the transfer belt unit stored in the main body of the image forming apparatus. Then, the image forming apparatus adjusts parameters on the inside of a machine to values optimum for the new transfer belt unit, and further, cuts the fuse of the transfer belt unit. Thereafter, an image is output, and then, operation is confirmed. Here, in the case where the malfunction is caused by the old transfer belt unit, the old transfer belt unit is replaced with a new transfer belt unit.

In contrast, in the case where the malfunction is caused by the main body of the image forming apparatus, the above-described initialization erases the use history of the old transfer belt unit. In other words, even if the normal old transfer belt unit is installed again for use in the apparatus as a result of the investigation, the transfer belt unit cannot be used with optimum parameters.

In addition, the fuse of the transfer belt unit for use in troubleshooting has been cut already at the time of the installation irrespective of temporary use in investigating the cause of the malfunction. In this case, the transfer belt unit cannot be recognized to be a new one unless a fuse is replaced, thereby inducing many wastes.

In a configuration provided with a fuse member in the transfer belt unit, an electric contact portion is indispensable between the transfer belt unit and the main body of the apparatus, and therefore, the configuration becomes complicated in order to secure stable electric conductivity. Thus, an increase in the number of component parts inhibits cost reduction.

SUMMARY OF THE INVENTION

An object of the present invention is to provide an image forming apparatus and a detachably attachable unit, in which a main body of the apparatus and the unit can be kept in a proper state even if an inspection is carried out with a new unit for the purpose of a diagnosis of a cause of a malfunction in the case where an abnormality occurs in the image forming apparatus provided with the unit.

Another object of the present invention is to provide an image forming apparatus including: a unit detachably attachable to a main body of the apparatus, wherein said unit includes a portion to be detected; a detecting device which detects the portion to be detected in said unit, wherein it is determined that said unit is in an unused state based on that both of a first state in which said portion to be detected is detected by said detecting device and a second state in which said portion to be detected is not detected by said detecting device are confirmed, then said first state or the second state is maintained; and a restricting member which inhibits said first state or said second state from being maintained.

Still another object of the present invention is to provide a unit detachably attachable to an image forming apparatus, including: a portion to be detected which is detected by a detecting device, wherein it is determined that said unit is in an unused state based on that both of a first state in which said portion to be detected is detected by said detecting device and a second state in which said portion to be detected is not detected by said detecting device are confirmed, then the first state or the second state is maintained; and a restricting member which inhibits said first state or said second state from being maintained.

Further features of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross-sectional view illustrating an image forming apparatus according to an embodiment of the present invention;

FIG. **2** is a perspective view illustrating a transfer belt unit to be installed in the image forming apparatus;

FIG. **3** is a view illustrating the abutment relationship between an intermediate transfer belt and an image bearing member in a full separation mode;

FIG. **4** is a view illustrating the abutment relationship between the intermediate transfer belt and the image bearing member in a full abutment mode;

FIG. **5** is a view illustrating the abutment relationship between the intermediate transfer belt and the image bearing member in a monochromatic mode;

FIG. **6** is a partially enlarged perspective view illustrating a transfer roller bearing and a separation rod;

FIGS. **7**A and **7**B are views illustrating the abutment and the separation between the transfer roller bearing and the separation rod;

FIGS. **8**A and **8**B are views illustrating an abutment/separation detecting mechanism for the intermediate transfer belt;

FIGS. **9**A and **9**B are enlarged views illustrating part of a new transfer belt unit detecting member and a unit frame;

FIGS. **10**A and **10**B are views illustrating a new transfer belt unit detecting mechanism which detects a new transfer belt unit (in the full separation mode);

FIGS. **11**A and **11**B are views illustrating the new transfer belt unit detecting mechanism immediately before the switch from the detection of the new transfer belt unit to the detection of an old transfer belt unit;

FIGS. **12**A and **12**B are views illustrating the new transfer belt unit detecting mechanism immediately after the switch from the detection of the new transfer belt unit to the detection of the old transfer belt unit;

FIGS. **13**A and **13**B are views partially illustrating the outside appearance for achieving a new transfer belt unit detection invalidating function;

FIG. **14** is a view illustrating the inside configuration for achieving the new transfer belt unit detection invalidating function;

FIGS. **15**A and **15**B are a partially enlarged view and a partial cross-sectional view illustrating an intermediate transfer belt abutment/separation drive train in the full abutment mode in a new transfer belt unit detection invalidation state;

FIG. **16** is a partially enlarged view illustrating the intermediate transfer belt abutment/separation drive train in the monochromatic mode in the new transfer belt unit detection invalidation state;

FIG. **17** is a view illustrating a configuration for preventing any falsification of detection of a new transfer belt unit;

FIG. **18** is a control block diagram illustrative of a control of a color image forming apparatus;

FIG. **19** is a control block diagram illustrative of an image memory portion;

FIG. **20** is a diagram illustrating a configuration of an external I/F processing portion;

FIG. **21** is a diagram illustrating a configuration of an image forming system;

FIG. **22** is a flowchart illustrating intermediate transfer belt abutment/separation detection; and

FIG. **23** is a flowchart illustrating detection of a new transfer belt unit.

DESCRIPTION OF THE EMBODIMENTS

An image forming apparatus according to embodiments of the present invention will be described below in detail with reference to the attached drawings.

First Embodiment

[General Configuration of Image Forming Apparatus]

A color image forming apparatus illustrated in FIG. **1** is provided with process cartridges **7** (**7***a*, **7***b*, **7***c*, and **7***d*) detachably attached to a main body **100** of the image forming apparatus.

The process cartridges are adapted to sequentially form yellow, magenta, cyan, and black images, respectively, wherein they are identical to each other in configuration except toners of different colors. Members a, b, c, and d illustrated in FIG. **1** correspond to image forming portions for yellow, magenta, cyan, and black, respectively. Hereinafter, reference characters a, b, c, and d will be omitted unless the colors need to be particularly distinguished.

The process cartridges **7** include drum units **4** (**4***a*, **4***b*, **4***c*, and **4***d*) and development units **5** (**5***a*, **5***b*, **5***c*, and **5***d*), respectively. Here, the drum units **4** include photosensitive drums **1** (**1***a*, **1***b*, **1***c*, and **1***d*) serving as image bearing members, charge rollers **2** (**2***a*, **2***b*, **2***c*, and **2***d*), drum cleaning blades **8** (**8***a*, **8***b*, **8***c*, and **8***d*), and waste toner containers, respectively. The development units **5** include development rollers **50** (**50***a*, **50***b*, **50***c*, and **50***d*) and developer applying rollers **51** (**51***a*, **51***b*, **51***c*, and **51***d*), respectively.

Disposed under the process cartridges **7** are scanner units **3** which expose each of the photosensitive drums **1** to light based on image signals.

The photosensitive drums **1** are electrically charged to a predetermined potential of a negative polarity by the charge rollers **2**, and then, electrostatic latent images are formed thereon by the scanner units **3**. The electrostatic latent images are reversely developed by the development units **5** with the application of toners of a negative polarity, and thus, yellow, magenta, cyan, and black toner images are formed.

In a transfer belt unit **120** constituted by unifying an intermediate transfer belt (i.e., an intermediate transfer member), an intermediate transfer belt **12***e* serving as an endless belt member is stretched across a drive roller **12***f*, a secondary transfer counter roller **12***g*, and a tension roller **12***h*. The tension roller **12***h* is urged in a direction indicated by an arrow B, to apply a tension onto the intermediate transfer belt **12***e*. Moreover, primary transfer rollers **12** (**12***a*, **12***b*, **12***c*, and **12***d*) are arranged inside of the intermediate transfer belt **12***e* in a manner facing the photosensitive drums **1**, respectively. In this way, a transfer bias is designed to be applied by a bias applying unit, not illustrated.

In forming images, the photosensitive drums **1** are rotated, so that the intermediate transfer belt **12***e* is moved in a direction indicated by an arrow A. The toner images formed on the photosensitive drums **1** are transferred in sequence onto the intermediate transfer belt **12***e* with the application of a bias of a positive polarity to the primary transfer rollers **12**, thereby conveying the intermediate transfer belt **12***e* having the toner images of the four colors formed in superimposition to a secondary transfer portion **15**.

A sheet feeder **13** includes a feed roller **9** which feeds a transfer material P from a sheet cassette **11** containing the transfer material P serving as a recording material, and con-

veying rollers **10** which convey the fed transfer material P. The transfer material P conveyed from the sheet feeder **13** is further conveyed to the secondary transfer portion **15** by a pair of registration rollers **17**.

In the secondary transfer portion **15**, a bias of a positive polarity is applied to a secondary transfer roller **16**, thereby secondarily transferring, onto the conveyed transfer material P, the toner images of the four colors formed on the intermediate transfer belt **12***e*.

The transfer material P having the toner images transferred thereon is conveyed to a fixing device **14**, in which the material is then heated and pressurized by a fixing roller **141** and a pressure roller **142**, to have the toner images fixed thereon. The fixed transfer material P is discharged onto a discharge tray **21** by a pair of discharge rollers **20**.

Meanwhile, the toners remaining on the photosensitive drums **1** after the toner images are transferred are removed by the cleaning blades **8** (**8***a*, **8***b*, **8***c*, and **8***d*). Furthermore, the toner remaining on the intermediate transfer belt **12***e* after the secondary transfer onto the transfer material P is removed by an intermediate transfer belt cleaner **22**. The removed toner passes a waste toner conveyance path, not illustrated, (as indicated by a broken arrow in FIG. **1**), to be recovered to a waste toner recovery vessel **23**.

[Abutment/Separation Mechanism of Intermediate Transfer Belt]

Subsequently, an abutment/separation mechanism of the intermediate transfer belt in the image forming apparatus according to the present embodiment will be described below with reference to FIGS. **2** to **8**B. Members designated by reference characters R and L in the drawings correspond to the right and left in a widthwise direction of the intermediate transfer belt (i.e., in a direction perpendicular to a movement direction), but reference characters R and L are omitted if the right and the left need not be particularly distinguished.

In the color image forming apparatus in the present embodiment, the intermediate transfer belt **12***e* can abut against or be separated from the photosensitive drums **1** in the process cartridges **7**. Therefore, three modes described below can be selected in recording.

A first mode signifies a color mode (a full abutment mode) in which the intermediate transfer belt **12***e* abuts against all of the photosensitive drums **1**, thereby achieving multi-color recording in superimposition of the plurality of colors. A second mode signifies a monochromatic mode in which the intermediate transfer belt **12***e* abuts against only one photosensitive drum **1**, thereby achieving monochromatic recording. A third mode signifies a full separation mode in which the intermediate transfer belt **12***e* is separated from all of the photosensitive drums **1**.

FIG. **2** is a perspective view illustrating the schematic configuration of the transfer belt unit **120**, wherein the photosensitive drums **1** face the transfer belt unit **120**. The transfer belt unit **120** is detachably attachable to the main body of the apparatus. When the transfer belt unit **120** is consumed due to the use, it can be replaced with a new one.

The mechanism, which allows the intermediate transfer belt **12***e* and the four primary transfer rollers **12***a*, **12***b*, **12***c*, and **12***d* to abut against or be separated from the photosensitive drums **1**, is housed in a space defined by the three tension rollers, that is, the drive roller **12***f*, the driven roller **12***g*, and the tension roller **12***h*.

Drive force is transmitted from the main body **100** of the image forming apparatus to the transfer belt unit **120** via a coupling **98** by a drive output portion, not illustrated (as indicated by a solid straight arrow in FIG. **2**). A first separation gear **95** engages with the coupling coaxially with the coupling **98**. The first separation gear **95** is geared to a third separation gear **97** via second separation gears **96***a*, **96***b*, and **96***c* serving as three idler gears. Fixed coaxially with the third separation gear **97** are a separation shaft **93** and separation cams **94***a* and **94***b* at both ends of the shaft.

The number of teeth of the first separation gear **95** is **17**, and further, the number of teeth of the third separation gear **97** is triple (a factor of a natural number), that is, 51. Thus, one rotation of the coupling **98** and ⅓ rotation of the third separation gear **97** are controlled every ON/OFF of a solenoid by a chipped gear and a solenoid, neither illustrated, disposed upstream of the drive of the coupling **98**.

The coupling **98** and the third separation gear **97** are rotated in a direction indicated by an arrow X in FIG. **2**. As for the rotation control, the same function may be fulfilled by utilizing a rotational angle control by a stepping motor or a drive control unit such as an electromagnetic clutch, besides the configuration of the chipped gear and the solenoid.

First separation rods **92***a* and second separation rods **92***b* are arranged on both sides in a widthwise direction of the intermediate transfer belt **12***e*. These separation rods **92***a* and **92***b* are slidably fixed in the arrangement direction of the plurality of photosensitive drums **1** so as to allow the photosensitive drums **1** to abut against or be separated from the intermediate transfer belt **12***e*.

Separation rods **92***a*R and **92***b*R are connected to the separation cam **94***a* whereas separation rods **92***a*L and **92***b*L are connected to the separation cam **94***b*. The connected separation rods slide in substantially the same direction as the arrangement direction of the plurality of photosensitive drums **1** (as indicated by a broken arrow in FIG. **2**) according to the rotation of the separation cams **94***a* and **94***b*.

FIG. **3** is a cross-sectional view schematically illustrating the full separation mode (i.e., the third mode); FIG. **4** is another cross-sectional view schematically illustrating the full abutment mode (i.e., the first mode); and FIG. **5** is still another cross-sectional view schematically illustrating the monochromatic mode (i.e., the second mode).

At the time of OFF of a power source and in a standby status of the apparatus except the case of an abnormality such as an instant outage of power supply, the intermediate transfer belt **12***e* is separated in the full separation mode in which the transfer rollers **12** are retracted from the photosensitive drums **1** in the units of all of the colors in the present embodiment. This is because if the intermediate transfer belt **12***e* is left abutting against the photosensitive drums **1** for a long period of time, the intermediate transfer belt **12***e* or the transfer rollers **12** may be locally subjected to plastic deformation typified by "creeping," thereby degrading an image quality after the transfer belt **12***e* is left.

Securing a clearance can help avoid the mutual slide between the photosensitive drum **1** and the intermediate transfer belt **12***e* as much as possible at the time of the replacement of the process cartridge **7** or the transfer belt unit **120**.

As described above, the ⅓ rotation control of the third separation gear **97** is achieved by the ON/OFF of the solenoid, so that the intermediate transfer belt **12***e* is shifted with respect to the photosensitive drums **1** in states illustrated in FIG. **2**, FIG. **3**, FIG. **4** and FIG. **2** in sequence. In other words, the full separation mode, the full color mode, the monochromatic mode, and the full separation mode (i.e., the original full separation mode) are transited in sequence everyone rotation of the coupling **98** in the direction indicated by the arrow X in FIG. **2**.

The above-described configuration will be specifically described with reference to FIGS. **3** to **5**. The separation rods **92***a* and **92***b* slide in the direction substantially parallel to the

arrangement direction of the photosensitive drums **1** (i.e., in the direction indicated by arrows in the drawings) via the third separation gear **97** and the separation cam **94** upon the rotation of the first separation gear **95**. As following the slide, the transfer rollers **12** are moved by moving transfer roller bearings **91** (**91***a*R, **91***b*R, **91***c*R, **91***d*R, **91***a*L, **91***b*L, **91***c*L, and **91***d*L) forward or reversely in a pressurization direction of transferring/pressurizing springs **90** (**90***a*R, **90***b*R, **90***c*R, **90***d*R, **90***a*L, **90***b*L, **90***c*L, and **90***d*L), thus achieving the abutment or separation between the photosensitive drums **1** and the intermediate transfer belt **12***e*.

Incidentally, the first separation rods **92***a* achieve the abutment or separation between the photosensitive drums **1***a*, **1***b*, and **1***c* in the image forming portions for the yellow, magenta, and cyan colors and the intermediate transfer belt **12***e*. In contrast, the second separation rods **92***b* achieve the abutment or separation between the photosensitive drum **1***d* in the image forming portion for the black color and the intermediate transfer belt **12***e*.

Here, the shifts of the separation rods **92***a* and **92***b* during the transition in each of the modes will be described below. During the transition from the full separation mode to the full color mode, the first separation rods **92***a* and the second separation rods **92***b* are moved in a direction indicated by the arrow in FIG. **3**. Thus, all of the primary transfer rollers **12** abut against the intermediate transfer belt **12***e*, which in turn abuts against the photosensitive drums **1**, as illustrated in FIG. **4**.

Next, during the transition from the full color mode to the monochromatic mode, only the first separation rods **92***a* are moved in a direction indicated by the arrow in FIG. **4**. Thus, the primary transfer rollers **12***a*, **12***b*, and **12***c* for the yellow, magenta, and cyan colors are separated from the intermediate transfer belt **12***e*, which in turn is separated from the photosensitive drum **1***a*, **1***b*, and **1***c*, as illustrated in FIG. **5**.

During the transition from the monochromatic mode to the full separation mode, only the second separation rods **92***b* are moved in a direction indicated by the arrow in FIG. **5**. In this manner, the primary transfer roller **12***d* for the black color also is separated from the intermediate transfer belt **12***e*, which also is separated from the photosensitive drum **1***d*, as illustrated in FIG. **3**. In this manner, the mode is returned to the full separation mode.

The relationship between the separation rod **92** and the transfer roller bearing **91** will be described with reference to FIGS. **6**, **7**A, and **7**B, which are partially enlarged views illustrating the separation rod **92** and the transfer roller bearing **91**.

FIG. **6** illustrates a boss portion **91***n*R at the transfer roller bearing **91***d*R in the black image forming portion as atypical example mounted on a cam shaped portion (an inclined portion) **91***k* at the second separation rod **92***b*R. As described above, when the second separation rod **92***b* slides, the boss portion **91***n*R is oscillated on an oscillation center **91***h*R of the transfer roller bearing **91***d*R owing to the cam shape of the second separation rod **92***b*R, as indicated by an arrow in FIG. **6**. As a consequence, the transfer roller bearing **91** and the primary transfer roller **12** are moved in a substantially vertical direction in FIGS. **7**A and **7**B, thereby achieving the abutment against or separation from the intermediate transfer belt **12***e*. Incidentally, FIG. **7**A illustrates the separation status whereas FIG. **7**B illustrates the abutment status.

Subsequently, the configuration of an abutment/separation detecting unit which is adapted to detect the abutment or separation between the intermediate transfer belt **12***e* and the photosensitive drum **1** will be described with reference to FIGS. **8**A and **8**B.

As illustrated in FIGS. **8**A and **8**B, an abutment/separation detecting member **506** is disposed on the side of the transfer belt unit **120** whereas an abutment/separation detecting sensor **505** and an abutment/separation detecting flag **600** are disposed on the side of the main body **100** of the image forming apparatus. Here, the abutment/separation detecting sensor **505** is exemplified by a photointerrupter in the present embodiment. FIG. **8**A illustrates a detection status in the monochromatic mode and the full separation mode whereas FIG. **8**B illustrates a detection status in the full color mode.

The abutment/separation detecting member **506** disposed at a part of the first separation rod **92***a*L does not push up the abutment/separation detecting flag **600**, so as not to intercept the sensor in the modes other than the first mode (FIG. **8**A). In contrast, the abutment/separation detecting member **506** pushes up the abutment/separation detecting flag **600** according to the slide of the first separation rod **92***a*L, so as to intercept the sensor in the first mode (FIG. **8**B).

The movements of the drive train from the coupling **98** to the separation cam **94** and the separation rod **92** are uniquely determined in such a manner as to intercept the abutment/separation detecting sensor **505** only in the first mode except the malfunction of the sensor per se or the abutment/separation detecting member **506**, thereby securing the relationship between these phases.

[Mechanism for Detecting New Transfer Belt Unit]

Next, a new unit detecting mechanism which detects whether or not the transfer belt unit **120** is replaced with a new one will be described with reference to FIGS. **2**, **9**A, and **9**B to **12**B.

As illustrated in FIG. **2**, a new unit detecting mechanism in the present embodiment is exemplified by a new unit detecting member **502** serving as a rotary member which detects whether or not the transfer belt unit **120** is new, the member **502** being disposed coaxially with the rotary shaft of the third separation gear **97**; and a new unit detecting sensor **504** serving as a detecting device which detects the new unit detecting member **502**, the sensor **504** being disposed in the vicinity of the new unit detecting member **502**. Here, the new unit detecting sensor **504** is exemplified by a photointerrupter in the present embodiment.

In the present embodiment, there is provided a moving unit which moves the new unit detecting member **502** at a non-association position at which it cannot be associated with the transition of the belt unit due to the mode switch after the new unit detecting member **502** is moved in association with the first mode switch after the transfer belt unit **120** is installed in the main body of the apparatus. In this manner, it is determined whether or not the transfer belt unit **120** is new by detecting the new unit detecting member **502**.

FIG. **9**A is an enlarged view illustrating the new unit detecting member **502**. In the new unit detecting member **502**, a flag portion **509** to be detected projects from a disk-like member, and further, holes **502***c* and **502***d* are bored at positions deviated from the rotational center. At the side surface of the new unit detecting member **502**, cam portions **502***a* and **502***b* are formed into a cam shape gradually projecting in a direction of the rotary shaft and concentrically with the rotational center.

The flag portion **509** is adapted to intercept the light incident into the sensor **504**. The holes **502***c* and **502***d* engage with boss portions **97***a* and **97***b* disposed at the side surface of the third separation gear **97** (FIGS. **10**A and **10**B), so that the new unit detecting member **502** can be rotated integrally with the third separation gear **97**. In addition, the cam portions **502***a* and **502***b* abut against a frame **80** of the transfer belt unit.

As illustrated in FIG. **9**B, cam shaped portions **80***a* and **80***b* in conformity with the cam portions **502***a* and **502***b* are disposed at a part of the frame **80** of the transfer belt unit.

FIGS. **10**A and **10**B are views illustrating the new unit detecting member **502**, the new unit detecting sensor **504** disposed in the vicinity of the new unit detecting member **502**, and the drive train responsible for the abutment/separation of the intermediate transfer belt when the transfer belt unit **120** is new and in the full separation mode. In other words, FIGS. **10**A and **10**B illustrate the first state in which the flag portion **509** is detected by the new unit detecting sensor **504**. Moreover, FIGS. **11**A and **11**B are views illustrating the status of the new unit detecting member **502** immediately before the new unit is consumed to become old. In other words, FIGS. **11**A and **11**B illustrate the second state in which the flag portion **509** is not detected by the new unit detecting sensor **504**. Additionally, FIGS. **12**A and **12**B are views illustrating the status of the new unit detecting member **502** immediately after the new unit is consumed to become old. FIGS. **10**A, **11**A, and **12**A are perspective views illustrating the vicinity of the third separation gear **97** and the new unit detecting member **502** whereas FIGS. **10**B, **11**B, and **12**B are partial cross-sectional views illustrating the vicinity thereof.

When a new transfer belt unit **120** is installed, the intermediate transfer belt **12***e* is in the full separation mode. In addition, the holes **502***c* and **502***d* at the new unit detecting member **502** engage with the boss portions **97***a* and **97***b* at the third separation gear **97**, so that the new unit detecting member **502** can be rotated in association with the third separation gear **97**.

At this time, as illustrated in FIG. **10**B, the cam portions **502***a* and **502***b* at the new unit detecting member **502** abut against a part of the frame **80** except the cam shaped portions **80***a* and **80***b*. As a consequence, the holes **502***c* and **502***d* cannot be detached from the boss portions **97***a* and **97***b* at the third separation gear **97** against the urging force of a compression spring **99**. At this time, the flag portion **509** intercepts the light incident into the sensor **504** in a new unit detection state.

When the third separation gear **97** is rotated by ⅓ rotation (i.e., at an angle of 120° from the above-described state (in a direction indicated by an arrow in FIG. **10**A), the flag portion **509** cannot intercept the light incident into the sensor **504**, and further, the mode is transited to the full abutment mode, as illustrated in FIGS. **11**A and **11**B. At this time, projections of the cam portions **502***a* and **502***b* at the new unit detecting member **502** rotated integrally with the third separation gear **97** engage to be fitted into recesses of the cam shaped portions **80***a* and **80***b* on the side of the frame **80**. Consequently, the new unit detecting member **502** is moved by the resiliency of the compression spring **99** in a direction indicated by an arrow in FIG. **11**B.

As a consequence, the new unit detecting member **502** is turned into the states illustrated in FIGS. **12**A and **12**B. Hence, the holes **502***c* and **502***d* at the new unit detecting member **502** are disengaged from the boss portions **97***a* and **97***b* at the third separation gear **97**. Once the holes **502***c* and **502***d* are disengaged from the boss portions **97***a* and **97***b*, the rotational force cannot be transmitted to the new unit detecting member **502**, and therefore, the cam portions **502***a* and **502***b* remain engaged with the cam shaped portions **80***a* and **80***b*. Thus, the new unit detecting member **502** and the third separation gear **97** are located at a non-association position at which they can never engage with each other, so that the new unit detecting member **502** is kept to be permanently housed inside the frame **80**.

In this manner, an interception signal is never input into the new unit detecting sensor **504**, and therefore, it can be determined whether the transfer belt unit **120** is new or old. Specifically, the first state is turned into the second state, and thereafter, the confirmation of the kept second state determines that the transfer belt unit **120** is an unused unit.

[New Unit Detection Invalidating Function]

As described above, in the case where a malfunction occurs in the image forming apparatus, it is necessary to inspect the cause of the malfunction by distinguishing the causes by the main body of the image forming apparatus and by the transfer belt unit. At this time, if a new transfer belt unit is carelessly detected, the use history of the transfer belt unit **120** used until then and at which no malfunction occurs actually may be accidentally erased.

In view of this, a restricting unit which restricts the new unit detecting member **502** from being moved to the non-association position is provided in the present embodiment, and further, a mode in which the new unit detection is invalidated (a troubleshooting mode) is provided for the transfer belt unit **120**. A restricting configuration will be described below.

As illustrated in FIG. **13**A, a detection preventing portion **80***c* and a hook portion **80***d* serving as fixing portions for use in fixing a detection preventing member **82** as a restricting member, as described later, are formed at a part of the frame **80** in the transfer belt unit. The detection preventing member **82** serves as the restricting member which restricts the new unit detecting member **502** from being moved to the above-described non-association position, and it is formed by bending an end of a rod-like member at a right angle. In other words, the restricting member inhibits the second state from being maintained.

FIG. **13**B illustrates a configuration in which the detection preventing member **82** is fixed to the detection preventing portion **80***c*. FIG. **14** is a view similar to FIG. **13**B except the removal of the frame **80** for the sake of easy understanding.

As illustrated in FIG. **13**A, the detection preventing portion **80***c* is a fixing hole bored at a position facing the new unit detecting member **502**. The detection preventing member **82** is inserted at one end thereof into the fixing hole whereas it is locked at the other end thereof to the hook portion **80***d*.

As described above, when a new unit detection operation is performed in the state in which the detection preventing member **82** is fixed, the status is changed as follows: namely, the new unit detecting member **502** is to be moved rightward in FIG. **11**B (in the direction of the rotary shaft, that is, a thrust direction) at the time of the transition from the state illustrated in FIGS. **11**A and **11**B to the state illustrated in FIGS. **12**A and **12**B, as described above. However, since the detection preventing member **82** is inserted into the detection preventing portion **80***c*, the new unit detecting member **502** cannot be moved in the thrust direction due to the abutment against the detection preventing member **82**. Consequently, the new unit detecting member **502** is kept in engagement with the third separation gear **97**.

Moreover, even in the case of the switch from the full color mode (i.e., a state illustrated in FIGS. **15**A and **15**B) to the monochromatic mode (i.e., a state illustrated in FIG. **16**), the engagement is kept, so that the mode can be returned to the full separation mode (i.e., a home position) while the new unit is kept again. That is to say, in the case of the switch from the first state to the second state and the switch from the second state to the first state, the main body of the apparatus is inhibited from being set to image forming conditions which are set when the transfer belt unit **120** is an unused unit. This operation is performed together with a detection control, as described below, so that the new unit detection can be invali-

dated without any physical breakage of the new unit detecting mechanism, thereby achieving the troubleshooting mode.

Incidentally, as for the troubleshooting mode, in the case of the use while, for example, a member having the same function as that of the state change detection preventing member **82** remains fixed to the detection preventing portion **80***c*, the unit substantially consumed through the use may be accidentally detected as a new unit.

To solve the above-described problem, a falsification preventing seal (i.e., a cover member) **83** on which a visual scar remains upon peel-off is stuck onto the detection preventing portion **80***c*, which is thus covered, as illustrated in, for example, FIG. **17**. Thus, the scar of the peel-off of the seal remains, and further, an accident can be prevented by an alarm of, for example, "never insert member into hole" after peeling. Here, a well-known falsification preventing seal may be used.

[Control Relevant to Intermediate Transfer Belt Abutment/Separation Detection and New Unit Detection]

FIG. **18** is a control block diagram illustrative of the control of the color image forming apparatus in the present embodiment. Connected to a CPU **171** which performs a basic control of the image forming apparatus **100** are a ROM **174**, in which a control program is written, a work RAM **175** which performs processing, and an input/output port I/O **173** via address buses and a data bus, respectively. Connected to the input/output port I/O **173** are various kinds of loads (not illustrated) such as a motor and a clutch constituting the image forming apparatus and an input (not illustrated) from a sensor which detects the position of a sheet.

The CPU **171** controls input/output in sequence according to the contents of the ROM **174** via the input/output port I/O **173**, so as to perform an image forming operation. Moreover, an operation portion **172** is connected to the CPU **171**, thereby controlling a display unit and a key input unit in the operation portion **172**. An operator instructs the CPU **171** of the image forming operation mode or the switch of the display via the key input unit, so that the CPU **171** displays the state of the image forming apparatus **100** or the operation mode set by the key input.

Connected to the CPU **171** are an external I/F processing portion **400** which transmits/receives image data, processing data and the like to/from external equipment, an image memory portion **300** which extends or temporarily stores the image, and an image engine portion **200** which performs processing so as to expose line image data transferred from the image memory portion **300** by the scanner unit **3**.

FIG. **19** is a control block diagram illustrative of the image memory portion **300** in the present embodiment. The image memory portion **300** makes access to the image input/output such that the image data received from the external I/F processing portion **400** is written in a page memory **301** constituted of a memory such as a DRAM via a memory controller **302**, and further, reads the image to the image engine portion **200**. The memory controller **302** determines whether or not the image data received from the external equipment, that is, the external I/F processing portion **400** is compressed data. If it is determined that the image data is compressed data, the data is extended by the use of a compressed data extending processing portion **303**, and then, the data is written in the page memory **301** via the memory controller **302**.

The memory controller **302** generates a DRAM refresh signal in the page memory **301**, and further, adjusts access to the page memory **301** according to the writing from the external I/F processing portion **400** and the reading to the image engine portion **200**. Moreover, the memory controller **302** controls a writing address to the page memory **301**, a reading address from the page memory **301**, and a reading direction in accordance with the instruction from the CPU **171**.

The configuration of the external I/F processing portion **400** will be described with reference to FIG. **20**. The external I/F processing portion **400** receives the image data and print command data which are transmitted from external devices **500** via any one of a USB I/F **401**, a Centronics I/F **402**, and a network I/F **403**. In addition, the external I/F processing portion **400** transmits status information on the image forming apparatus, which is determined by the CPU **171**, to the external devices **500**.

The external device **500** is exemplified by a computer or a work station. The print command data received from the external device **500** via any one of the USB I/F **401**, the Centronics I/F **402**, and the network I/F **403** is processed in the CPU **171**. Setting conditions or timing of the print operation are produced by using the image engine portion **200** or the input/output port I/O **173**. In contrast, the image data received from the external device **500** via any one of the USB I/F **401**, the Centronics I/F **402**, and the network I/F **403** is transmitted to the image memory portion **300** in accordance with the timing based on the print command data. Hence, the data is processed so as to form the image in the image forming portion.

FIG. **21** is a diagram illustrating the configuration of an image forming system in the present embodiment. The transfer belt unit **120** is constituted of the intermediate transfer belt **12***e*, the drive roller **12***f*, the secondary transfer counter roller **12***g*, the tension roller **12***h*, and the primary transfer rollers **12***a*, **12***b*, **12***c*, and **12***d*.

The new unit detecting member **502** in the transfer belt unit is located at the end of the transfer belt unit **120**.

The new unit detecting sensor **504** is adapted to detect penetration or interception in an optical sensor, as described above. The new unit detecting member **502** varies an output from the sensor **504** in a predetermined mode, so as to determine whether the transfer belt unit **120** is new or old. The CPU **171** is notified of a result detected by the new unit detecting sensor **504** through the input/output port **173**.

The abutment/separation detecting sensor **505** is adapted to detect the abutment/separation state of the intermediate transfer belt **12***e* against/from the drum.

A count unit **507** is designed to count the consumption of the transfer belt unit **120**. The consumption is exemplified by an accumulated print amount from zero in a new transfer belt unit **120** up to then (a print dot amount added with a print ratio, i.e., a so-called pixel count) or an image formation time (an operation time). The count is stored in a counter **508**.

Unit information **510** is parameters for use in forming an image according to characteristics of the transfer belt unit **120**. The unit information **510** is determined in accordance with the result of initialization performed when an image forming unit **501** is first installed in the image forming apparatus. In the present embodiment, a transfer voltage/current is controlled. The transfer voltage/current of the primary transfer portion or the secondary transfer portion is controlled according to a change in resistance when the intermediate transfer belt **12***e*, the primary transfer rollers **12***a*, **12***b*, **12***c*, and **12***d*, and the driven roller **12***g* are used for a long period of time, thereby providing a desired transfer condition.

The unit information **510** is stored in a non-volatile RAM region inside of the image forming apparatus. A unit information holding unit **511** is adapted to store (retract) the unit information **510** which has been used (disposed) for a predetermined period in the case of the replacement of the transfer belt unit **120**. The unit information holding unit **511** is stored

in the non-volatile RAM region inside of the image forming apparatus, like the unit information **510**.

Next, a description will be given of detection and control relevant to an operation for identifying new and old units. For the sake of prevention of complicated description, FIG. **22** is a flowchart illustrating the abutment/separation detection by the transfer belt unit **120** in the present basic image forming apparatus before the description of the operation for identifying the new and old units.

The transfer belt unit **120** is not always in the full separation mode, that is, at its home position due to an abrupt stoppage of a supply power source. After power ON (S**601**), the abutment/separation operation is repeated until the abutment/separation detecting sensor **505** detects the interception, that is, reaches the full abutment mode, thereby grasping the state in any one of the full separation mode, the full abutment mode, and the monochromatic mode (S**602** to S**607**). Thereafter, it is determined whether or not the abutment/separation detecting sensor **505** per se is out of working order (S**608** to S**610**), thereby returning to the full separation mode. In this manner, the detection comes to an end (S**612** to S**614**).

FIG. **23** is a flowchart illustrating a new unit identifying (new unit detecting) operation of the transfer belt unit **120** in the present image forming apparatus and identifying operation in the new unit detection invalidating mode (i.e., in the troubleshooting mode).

In step S**701**, the power source is turned on in the image forming apparatus, and then, the new unit detecting sensor **504** first performs the detection in step S**702**. In the case where the new unit detecting sensor **504** is not intercepted by the new unit detecting member **502**, only the abutment/separation detecting mode is carried out (S**703**).

In contrast, in the case where the new unit detecting sensor **504** is intercepted by the new unit detecting member **502** in step S**702**, the unit **120** is in the full separation mode except the malfunction of the sensor, so that the abutment and separation modes are switched until the mode becomes the full separation mode again. At this time, the malfunction of the sensor **504** is appropriately screened (S**704** to S**711**).

In step S**712**, in the case of the penetration in the new unit detecting sensor **504**, it is determined that the transfer belt unit **120** is new, thereby clearing the counter **508**, followed by the initialization for determining the unit information **510** for achieving the image formation according to the characteristics of the transfer belt unit **120**. Upon the completion of the initialization, the image forming apparatus stands by (S**714** and S**715**).

In contrast, in the case of the interception in the new unit detecting sensor **504** in step S**712**, it is determined that the transfer belt unit **120** is in the new unit detection invalidating mode. Thereafter, the transfer belt unit **120** may remain consumed without any replacement or may be replaced with another consumed image forming unit **501**, although very rarely presumed. In view of this, the unit information **510** is not updated, so that the image forming apparatus stands by (S**713** to S**715**). At this time, the troubleshooting mode may be displayed on the operation portion **172**. In this manner, the detection comes to an end (S**716**).

Here, the counter **508** in the transfer belt unit **120** is operated as follows.

In the image forming apparatus, the count in the counter **508** is updated every image formation. Upon the completion of the image formation, the CPU **171** and the ROM **174** determine whether or not the count in the counter **508** reaches a predetermined value or more. If it is determined that the count is the predetermined value or more, a user is alerted to a given matter such as a replacement timing of the transfer belt unit **120** by displaying it on the operation portion **172**. Simultaneously with the alert display, an image forming operation thereafter is limited, to be thus controlled to keep a good quality of an image. Like in the present embodiment, in the case where the transfer belt unit **120** is determined to be new (S**714**), the counter **508** is reset, thereby starting to record the use history of the unit again.

In the above-described present embodiment, the image forming apparatus **100** is applied to the image forming apparatus in which the toner images formed on the plurality of photosensitive drums **1** are primarily transferred onto the intermediate transfer belt **12***e*, and then, the toner images are secondarily transferred onto the transfer material conveyed.

However, the present invention is not limited to the image forming apparatus which uses the intermediate transfer belt **12***e*. The present invention may be applied to, for example, an image forming apparatus in which a transfer material conveying belt serving as the transfer material bearing member for bearing the transfer material is disposed in such a manner as to freely abut against or be separated from a plurality of image bearing members, and thus, toner images are transferred in sequence onto a transfer material P to be conveyed by the transfer material conveying belt, thereby forming a recording image.

By way of the above-described embodiment, the description has been given of the example in which the first state is shifted to the second state, and then, the second state is maintained. Here, the present invention may be applied to an example in which the second state is shifted to the first state, and then, the first state is maintained.

While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

This application claims the benefit of Japanese Patent Application No. 2008-120916, filed May 7, 2008, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. A belt unit that is detachably attachable to an image forming apparatus, the belt unit comprising:

a first rotary member that rotates by transmitting a driving force;

a second rotary member that is movable in an axial direction of the first rotary member, the second rotary member abutting the first rotary member to be able to rotate together with the first rotary member;

a frame portion that covers the second rotary member; and

an elastic member that moves the first rotary member and the second rotary member away from each other,

wherein the second rotary member includes an engaging portion that is engageable with a portion of the frame portion to be engaged,

the second rotary member rotates together with the first rotary member when the engaging portion does not engage the portion to be engaged, and the second rotary member is separated from the first rotary member by the elastic member when the engaging portion opposes the portion to be engaged,

the engaging portion engages the portion to be engaged by separating the second rotary member from the first rotary member, and

the portion to be engaged is a positioning portion that positions the second rotary member separated from the first rotary member.

2. The belt unit according to claim 1, wherein the second rotary member includes a portion to be detected, which is detected by a detecting member.

3. The belt unit according to claim 2, wherein the portion to be detected projects from the frame portion when the engaging portion does not engage the portion to be engaged, and the portion to be detected is covered with the frame portion when the engaging portion engages the portion to be engaged.

4. The belt unit according to claim 1, wherein the first rotary member includes a boss portion, the second rotary member includes a hole portion that engages the boss portion, and the boss portion engages the hole portion when the second rotary member rotates together with the first rotary member.

5. The belt unit according to claim 1, wherein the engaging portion of the second rotary member comprises a projection portion that projects toward the frame portion in an opposite surface opposing the frame portion.

6. The belt unit according to claim 5, wherein the projection portion abuts the opposite surface opposing the frame portion when the second rotary member rotates together with the first rotary member.

7. The belt unit according to claim 6, wherein the opposite surface opposing the frame portion includes a recess portion as the portion to be engaged, and the recess portion engages the projection portion.

8. The belt unit according to claim 6, further comprising a rotating belt and a plurality of transfer members that can be abutted on and separated from the belt,

wherein the first rotary member is a gear that switches an abutment/separation state of the plurality of transfer members with respect to the belt.

9. The belt unit according to claim 1, wherein the frame portion includes an attachment portion for a regulating member, the regulating member maintaining a state in which both the second rotary member and the first rotary member rotate.

10. An image forming apparatus comprising:

a first rotary member that rotates by transmitting a driving force;

a second rotary member that is movable in an axial direction of the first rotary member, the second rotary member abutting the first rotary member to be able to rotate together with the first rotary member;

a frame portion that covers the second rotary member;

an elastic member that moves the first rotary member and the second rotary member away from each other; and

a detecting device,

wherein the second rotary member includes an engaging portion that is engageable with a portion of the frame portion to be engaged, and a portion to be detected, which is detected by the detecting device,

the second rotary member rotates together with the first rotary member when the engaging portion does not engage the portion to be engaged, and the second rotary member is separated from the first rotary member by the elastic member when the engaging portion opposes the portion to be engaged,

the engaging portion engages the portion to be engaged by separating the second rotary member from the first rotary member,

the portion to be engaged is a positioning portion that positions the second rotary member separated from the first rotary member, and

the portion to be detected projects from the frame portion when the engaging portion does not engage the portion to be engaged, and the portion to be detected is covered with the frame portion when the engaging portion engages the portion to be engaged.

11. The image forming apparatus according to claim 10, wherein the detecting device is a photo-interrupter, and light of the photo-interrupter is blocked by the portion to be detected when the portion to be detected projects from the frame portion.

12. The image forming apparatus according to claim 10, wherein the first rotary member includes a boss portion, the second rotary member includes a hole portion that engages the boss portion, and the boss portion engages the hole portion when the second rotary member rotates together with the first rotary member.

13. The image forming apparatus according to claim 10, wherein the engaging portion of the second rotary member comprises a projection portion that projects toward the frame portion in an opposite surface opposing the frame portion.

14. The image forming apparatus according to claim 13, wherein the projection portion abuts the opposite surface opposing the frame portion when the second rotary member rotates together with the first rotary member.

15. The image forming apparatus according to claim 13, wherein the opposite surface opposing the frame portion includes a recess portion as the portion to be engaged, and the recess portion engages the projection portion.

16. The image forming apparatus according to claim 10, further comprising a belt unit that includes a belt, the belt unit being detachably attachable to a main body, and a control portion that determines a state of the belt unit according to a detection result of the detecting device.

17. The image forming apparatus according to claim 10, wherein the frame portion includes an attachment portion for a regulating member, the regulating member maintaining a state in which both the second rotary member and the first rotary member rotate.

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